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PHYSICS.—*The virial theorem for nonholonomic systems.*[1] R. J. SEEGER, The George Washington University.

The original statement[2] of Clausius' Virial Theorem is as follows: *Die mittlere lebendige Kraft des Systems ist gleich seinem Virial.* This is the same as is usually given in modern textbooks[3] despite the fact that it has been extended to include systems involving frictional forces,[4] relativistic mechanics[5] and wave-mechanics.[6] What has not been noted, however, is that each of these cases is a special form of a much more general theorem. And this is the very reason an analogous theorem can be derived that holds equally well for holonomic and for nonholonomic systems. The following proofs are given on the basis of relativistic mechanics.

Consider a holonomic dynamic system composed of m particles with mass m_i and velocity v_i. If there are n degrees of freedom, Lagrange's equations of motion (of the second form) may be written in terms of the generalized coördinates q_α, the generalized forces Q_α and the relativistic function T' as follows:

$$\frac{d}{dt}\left(\frac{\partial T'}{\partial \dot{q}_\alpha}\right) - \frac{\partial T'}{\partial q_\alpha} = Q_\alpha \qquad \alpha = 1, 2, \cdots, n$$

where

$$T' \equiv -\sum_{i=1}^{m} m_i c^2 \left(1 - \frac{v_i^2}{c^2}\right).$$

In this expression for T' the velocities v_i must be expressed as functions of the generalized coördinates and of the generalized velocities (c represents the velocity of light). Multiplying each of Lagrange's equations respectively by $D^K q_\alpha$, where

[1] Received August 13, 1934.
[2] CLAUSIUS, R. Ann. d. Phys. u. Chem. 2: 124. 1870.
[3] JEANS, J. H. *The dynamical theory of gases* (4th ed. 1925). 130. LOEB, L. B. *Kinetic theory of gases* (2nd ed. 1934). 153.
[4] MILNE, E. A. Phil. Mag. 50: 409. 1925.
[5] RUARK and UREY. *Atoms, molecules and quanta* (1930). 739.
[6] FINKELSTEIN, B. Zs. f. Phys. 50: 293. 1927. FOCK, V. Zs. f. Phys. 63: 855. 1930.

$$D^K q_\alpha \equiv \frac{d^K q_\alpha}{dt^K}$$

and using the identities

$$(D^K q_\alpha)\frac{d}{dt}\left(\frac{\partial T'}{\partial \dot{q}_\alpha}\right) \equiv \frac{d}{dt}\left\{(D^K q_\alpha)\frac{\partial T'}{\partial \dot{q}_\alpha}\right\} - (D^{K+1} q_\alpha)\frac{\partial T'}{\partial \dot{q}_\alpha}$$

we have

$$\frac{d}{dt}\left\{(D^K q_\alpha)\frac{\partial T'}{\partial \dot{q}_\alpha}\right\} - (D^{K+1} q_\alpha)\frac{\partial T'}{\partial \dot{q}_\alpha} - (D^K q_\alpha)\frac{\partial T'}{\partial q_\alpha} = (D^K q_\alpha)Q_\alpha$$
$$\alpha = 1, 2, \cdots, n.$$

Adding these n equations, we multiply the result by the differential of the time and integrate over a long period of time τ. Hence,

$$\int_0^\tau \sum_{\alpha=1}^n \frac{d}{dt}\left\{(D^K q_\alpha)\frac{\partial T'}{\partial \dot{q}_\alpha}\right\} dt - \int_0^\tau \sum_{\alpha=1}^n (D^{K+1} q_\alpha)\frac{\partial T'}{\partial \dot{q}_\alpha} dt$$
$$- \int_0^\tau \sum_{\alpha=1}^n (D^K q_\alpha)\frac{\partial T'}{\partial q_\alpha} dt = \int_0^\tau \sum_{\alpha=1}^n (D^K q_\alpha)Q_\alpha dt.$$

Dividing by the time τ, we have

$$\frac{1}{\tau}\left[\sum_{\alpha=1}^n \left\{(D^K q_\alpha)\frac{\partial T'}{\partial \dot{q}_\alpha}\right\}\right]_0^\tau - \frac{1}{\tau}\int_0^\tau \sum_{\alpha=1}^n (D^{K+1} q_\alpha)\frac{\partial T'}{\partial \dot{q}_\alpha} dt$$
$$- \frac{1}{\tau}\int_0^\tau \sum_{\alpha=1}^n (D^K q_\alpha)\frac{\partial T'}{\partial q_\alpha} dt = \frac{1}{\tau}\int_0^\tau \sum_{\alpha=1}^n (D^K q_\alpha)Q_\alpha dt.$$

If we now restrict the coördinates and velocities within a region of finite values, i.e., a steady state, we can take the time τ sufficiently long that the first term becomes relatively negligible, whereas the other terms represent average values. Thus

$$\frac{1}{2}\overline{\sum_{\alpha=1}^n (D^{K+1} q_\alpha)\frac{\partial T'}{\partial \dot{q}_\alpha}} + \frac{1}{2}\overline{\sum_{\alpha=1}^n (D^K q_\alpha)\frac{\partial T'}{\partial q_\alpha}} = -\frac{1}{2}\overline{\sum_{\alpha=1}^n (D^K q_\alpha)Q_\alpha}.$$

The expression on the right may be called the generalized virial and the entire relation the general virial theorem. It is customary to consider the special case for K equal to 0. Therefore

$$\frac{1}{2}\overline{\sum_{\alpha=1}^n \dot{q}_\alpha \frac{\partial T'}{\partial \dot{q}_\alpha}} + \frac{1}{2}\overline{\sum_{\alpha=1}^n q_\alpha \frac{\partial T'}{\partial q_\alpha}} = -\frac{1}{2}\overline{\sum_{\alpha=1}^n q_\alpha Q_\alpha}.$$

If T' is a homogeneous quadratic function of all the velocities $\dot{q}_\alpha$, the first term becomes simply T'. And in non-relativistic mechanics, where T' reduces to the kinetic energy T, it signifies the average energy of the system. We note, however, that this is not usually equal to the generalized virial on account of the non-momental part of the effective forces, which give rise to the term $\frac{1}{2}\overline{\sum_{\alpha=1}^{s} q_\alpha \frac{\partial T'}{\partial q_\alpha}}$. To be sure, we can formally modify our definition of the generalized virial to include this term. But regardless of the particular choice we make, the fact remains that it must be taken into account some place. The usual form of the virial theorem is accidental in that Cartesian coördinates are employed for which $\frac{\partial T'}{\partial q_\alpha}=0$. All the same, its simplicity of form and ease of physical interpretation render it more useful than the theorem in terms of generalized coördinates. As for the general virial theorem (K any value), it is still less convenient here, but very desirable for nonholonomic systems. Incidentally, we note that this theorem holds, not only for a steady state, but also for a periodic system if the average is taken over a time τ equal to an integral multiple of the fundamental period.

Let us now consider a nonholonomic dynamic system, i.e., one in which the essential minimum number of coördinates r is h more than the number of degrees of freedom n on account of h non-integrable relations, viz.,

$$\sum_{\alpha=1}^{r} a_{\alpha\beta} dq_\alpha + b_\beta dt = 0 \qquad \beta = 1, 2, \cdots, h$$

where $a_{\alpha\beta}$ and b_β are functions of the coördinates q_α and the time t. We can write Appell's equations of motion[7] in terms of n generalized coördinates q_γ (selected in a certain way from the all the r coördinates), modified forces Q_γ and the relativistic *energy of the accelerations* Λ as follows:

$$\frac{\partial \Lambda}{\partial \ddot{q}_\gamma} = Q_\gamma \qquad \gamma = 1, 2, \cdots, n$$

[7] SEEGER, R. J. This JOURNAL. 20: 481. 1930.

where

$$\Lambda = \frac{1}{2} \sum_{i=1}^{n} \frac{m_{i0}}{\left(1 - \frac{v_i^2}{c^2}\right)^{3/2}} (\ddot{x}_i^2 + \ddot{y}_i^2 + \ddot{z}_i^2).$$

The *energy of the accelerations* must be expressed as a function of the coördinates q_γ, the velocities $\dot{q}_\gamma$ and the accelerations $\ddot{q}_\gamma$. Proceeding in the same as in the proof for holonomic systems, we finally obtain

$$\frac{1}{2} \overline{\sum_{\gamma=1}^{n} (D^{K+1} q_\gamma)_1 \frac{\partial \Lambda}{\partial \ddot{q}_\gamma}} = -\frac{1}{2} \overline{\sum_{\gamma=1}^{n} (D^K q_\gamma) Q_\gamma}.$$

Let us call the expression on the right the generalized *virial of the accelerations*. Then we have a new form of the virial theorem, which is superior to that deduced from Lagrange's equations in that it holds for both holonomic and nonholonomic systems (the former is a special case of the latter for h equal to zero). We find it convenient to take K equal to one this time. Therefore

$$\frac{1}{2} \overline{\sum_{\gamma=1}^{n} \ddot{q}_\gamma \frac{\partial \Lambda}{\partial \ddot{q}_\gamma}} = -\frac{1}{2} \overline{\sum_{\gamma=1}^{n} \dot{q}_\gamma Q_\gamma}.$$

For, if Λ is a homogeneous quadratic function of $\ddot{q}_\gamma$, the term on the left becomes $\bar{\Lambda}$. And our theorem states that the average relativistic *energy of the accelerations* is equal to the *virial of the accelerations*. This is always true for Cartesian coördinates in nonrelativistic mechanics. This theorem is as simple as the usual virial theorem. But we conclude that in both cases the simplicity is not so much inherent in the dynamic system as it is the result of a judicious choice of the type of coördinates and of the value assigned to K.

CHEMISTRY.—*5-Chloroveratralhippuric acid and some of its derivatives.*[1] RAYMOND M. HANN. Private Laboratory of J. P. Wetherill, Washington, D. C. (Communicated by R. E. GIBSON.)

In prior communications the condensation of 5-chloroveratric aldehyde with aliphatic and aromatic amides,[2] and its conversion to 3, 4-dimethoxy-5-chlorobenzoic acid through hydrolysis of the nitrile formed by acetylation of the syn form of its oxime,[3] have been de-

[1] Received September 8, 1934.
[2] HANN. This JOURNAL, 24: 125. 1934.
[3] HANN. This JOURNAL, 24: 329. 1934.

scribed. The present paper records the condensation of this aldehyde with hippuric acid to form the azlactone of 5-chloroveratralhippuric acid, and the utilization of the latter in the preparation of some of the simpler derivatives of 5-chloroveratralhippuric acid. Further study is being made of the azlactone as an intermediate in the synthesis of 3, 4-dimethoxy-5-chlorophenylpyruric acid.

EXPERIMENTAL

5-Chloroveratralhippuric acid azlactone.—A solution of 5 g. 5-chloroveratric aldehyde, 4.5 g. of hippuric acid and 2 g. of pulverized fused sodium acetate in 25 cc. of acetic anhydride was heated under reflux on the steam bath. The solution rapidly changed in color from straw yellow to deep red and a yellow precipitate formed almost at once, completely filling the solution at the end of one-half hour, when the suspension was cooled and 100 cc. of water added. The yellow solid was filtered, washed with water and dried. Yield 6.9 g. (80% of theory).

5-Chloroveratralhippuric acid azlactone crystallizes from 95% alcohol (1 g. in 200 cc.) in radiating clusters of golden yellow glistening needles which melt at 161°C. (corr.) to a clear yellow oil.

Anal.—0.1591 g. consumed 4.82 cc. 0.1 N acid equivalent to 4.24% nitrogen. Theory for $C_{18}H_{14}O_4NCl$ is 4.08% nitrogen.

5-Chloroveratralhippuric acid.—A suspension of 3 g. of the azlactone in 30 cc. water and 7 cc. of 10% NaOH was refluxed for one-half hour when a clear solution resulted. The cold solution was acidified with dilute hydrochloric acid and the precipitated acid filtered, washed with water and dried. Yield 2.7 g. The acid was practically insoluble in water and was recrystallized from twenty parts of 50% alcohol for analysis.

5-Chloroveratralhippuric acid crystallizes in colorless, glistening needles melting at 192°C.

Anal.—0.1493 g. consumed 4.12 cc. 0.1 N acid equivalent to 3.86% nitrogen. Theory for $C_{18}H_{16}O_5NCl$ is 3.87% nitrogen.

5-Chloroveratralhippuramide.—A suspension of 2.5 g. of azlactone in 20 cc. of 95% alcohol and 10 cc. of strong ammonia solution in water was gently heated on the steam bath. The solution rapidly lightened in color and the yellow needles of azlactone were replaced by shining, colorless leaflets. After one-half hour 50 cc. of water was added and the precipitate filtered off and recrystallized from 150 cc. of 95% alcohol. Yield 2.1 g.

The substituted hippuramide crystallizes in microcrystalline, glist-

ening platelets melting at 213–4°C. (corr.) to a red oil with considerable decomposition. It is colorless when first crystallized, but becomes slightly yellow on standing.

Anal.—0.1687 g. consumed 9.44 cc. 0.1 N acid equivalent to 7.84% nitrogen. Theory for $C_{18}H_{17}O_4N_2Cl$ is 7.77% nitrogen.

5-Chloroveratralhippuramide.—One gram of the hippuramide, described above, was refluxed with 20 cc. of 10% sodium hydroxide and 30 cc. of water, the amide dissolving to give a clear intensely yellow solution. At the end of five minutes a yellow precipitate came down; the heating was discontinued, the cooled solution acidified to congo red by addition of 1:1 hydrochloric acid, and the precipitate filtered off and dried. It was recrystallized from 350 cc. 95% alcohol and was obtained in brilliant yellow needles melting at 286–7°C. (corr.) to a red tar-like liquid; this melting point remained unchanged by further recrystallization. The imide dissolves in sulfuric acid with production of an intense red color.

Anal.—0.1438 g. consumed 8.38 cc. 0.1 N acid equivalent to 8.16% nitrogen. Theory for $C_{18}H_{15}O_3N_2Cl$ is 8.18% nitrogen.

Methyl 5-chloroveratralhippurate.—Three grams of 5-chloroveratralhippuric acid azlactone were boiled under reflux with 30 cc. of anhydrous methyl alcohol and a granule of solid sodium hydroxide for eight minutes. Rapid solution and partial decolorization of the azlactone resulted and after cooling, water (18 cc.) was gradually added to bring about crystallization of the methyl ester. The yield of 2.5 g. was recrystallized from 50 cc. of 50% alcohol to constant melting point.

The methyl ester of 5-chloroveratralhippuric acid crystallizes in colorless, shining needles which melt at 135°C. (corr.) to a clear, colorless oil.

Anal.—Calcd. for $C_{19}H_{18}O_5NCl$: C, 60.70: H, 4.83.[4] Found: C, 60.69: H, 4.73, .1669 g. consumed 4.56 cc. 0.1 N acid equivalent to 3.83% nitrogen. Theory for $C_{19}H_{18}O_5NCl$ is 3.73% nitrogen.

Ethyl 5-chloroveratralhippurate.—This ester was prepared in the same manner as the methyl ester and crystallized in colorless, brilliant needles melting at 104°C. (corr.) to a clear oil.

Anal.—0.1546 g. consumed 3.95 cc. 0.1 N acid equivalent to 3.58% nitrogen. Theory for $C_{20}H_{20}O_5NCl$ is 3.60% nitrogen.

SUMMARY

5-Chloroveratralhippuric acid, its azlactone, amide, imide, and methyl and ethyl esters have been prepared and described.

[4] Appreciation is expressed to Dr. E. L. Jackson for this analysis.

BOTANY.—*Additional Costa Rican Mosses, III.*[1] EDWIN B. BARTRAM, Bushkill, Pennsylvania.

During the past three years many collections from various sources have added many new and interesting species to the Costa Rican moss flora. The number and variety of these additions indicate very plainly that the mosses of this comparatively small area are still imperfectly known. Undoubtedly further exploration, especially in the more inaccessible mountain regions, will expand the list of local species to a considerable extent. Under these circumstances it seems unwise to make up even a tentative list just yet, but I am hopeful that with the continued help of some of the active resident botanists it may be possible in the course of a few years to produce a fairly complete outline of the mosses of this rich and interesting region.

Professor Manuel Valerio, Director of the Museo Nacional in San José, continues to collect as far as his activities in the Museum will permit and expects shortly to make a trip to the Cerro del Chirripó, a practically unexplored region, from which much may be expected. As a direct result of the sustained activity and interest of Professor Anastasio Alfaro during the past year we owe the addition of many valuable records. To Señor Fed. Gutierrez, whose collections have been transmitted through the kindness of Professor Alfaro, we are indebted for an unusually valuable series of collections from the Banana River, in the low country along the Atlantic coast, which includes many novelties. The collections of C. W. Dodge and W. S. Thòmas were kindly entrusted to me by Dr. Dodge for determination and a small series, including a new species of *Squamidium*, was sent in by the collector, Professor H. E. Stork of Carleton College, Northfield, Minnesota. To these gentlemen I wish to express my profound thanks. It is mainly through their efforts and cooperation that the results detailed in the following list have been made possible.

FISSIDENTACEAE

FISSIDENS MOLLIS Mitt.

Banana River, 80 m., May 23, 1934, *F. Gutierrez;* San Luís de Turribares, 450 m., Prov. San José, July 15, 1933, *M. Valerio* 359.

The agreement between these specimens and collections from the Antilles is reasonably complete, and I have but little hesitation in crediting the species to Costa Rica.

FISSIDENS KEGELIANUS C. M.

Banana River, 80 m., May 14, 1934, May 23, 1934, June 9, 1934, *F. Gutierrez.*

[1] Received July 28, 1934.

This is one of the few minute species of the section Bryoidium that seems to be fairly well defined. The enlarged, lax areolation of the duplicate blades contrasts sharply with the smaller hexagonal cells of the apical and dorsal blades and appears to be a good diagnostic character. It is an interesting addition to the local flora.

FISSIDENS GARBERI Lesq. & James.

Roadsides south of Liberia, 100 m., Prov. Guanacaste, Jan. 16, 1930, *C. W. Dodge & W. S. Thomas* 6595.

Fissidens Garberi is new to the Costa Rican flora, but these plants are not exactly typical. The costa ends considerably below the apex, which is broadly rounded in many leaves, and the leaf cells are rather obscure and more coarsely papillose with sharp papillae. As these distinctions may not be of much consequence in such a large and intricate group of species, I am inclined to refer this collection here as an unusual form.

DICRANACEAE

TREMATODON LONGICOLLIS Michx.

Tilarán, 700 m., March 15, 1934, *A. Alfaro;* La Fuente, 1200 m., Dec. 27, 1933, *A. Alfaro* 47.

This is one of the smaller forms that might be referred to *T. reflexus* C. M., but, as Mrs. Britton has remarked[2] this species is probably only a small form of *T. longicollis*. It is an interesting new record for Costa Rica and helps to bridge the gap between Guatemala and the South American stations in Brazil and Bolivia.

DICRANELLA STANDLEYI Bartr.

Additional records for this endemic species are as follows: La Fuente, 1200 m., Oct. 16, 1933 and Dec. 27, 1933, *A. Alfaro.*

DICRANELLA BARBENSIS Ren. & Card.

Coronado, 1500 m., Jan. 7, 1934, *A. Alfaro.*

Although the peristome is up to 270μ high, almost twice the height given by Mr. Williams in North American Flora, this collection, which is in prime fruit, seems without much doubt to belong here. The teeth are coarsely papillose, not vertically striate, cleft to about the middle into 2 or 3 unequal prongs, and the leaf blade is produced nearly or quite to the apex so that the costa is barely percurrent.

CAMPYLOPODIUM PUSILLUM (Schp.) Williams.

Volcán Poás, 2500 m., Jan. 4, 1934, *A. Alfaro* 52a.

A number of fruiting plants of this attractive little species were separated from tufts of *Ceratodon stenocarpus*. This is the only collection I know of from Costa Rica.

[2] North American Flora, 15: 53. 1913.

CAMPYLOPUS FRAGILIS (Dicks.) Bry. Eur.

San Jerónimo, 1400 m., Nov. 15, 1933, *A. Alfaro.*

Not previously known from Costa Rica. This species will be separated from *C. flexuosus* (Hedw.) Brid. by the absence of any differentiated alar cells; also the leaf base is more contracted to the insertion.

LEUCOLOMA TORTELLUM (Mitt.) Jaeg.

Upper slopes of Cerro San José de Libano, 500–960 m., Prov. Guanacaste, Feb. 15, 1930, *C. W. Dodge, R. Hanckel, & W. S. Thomas* 7918.

The range of this unique species seems to be gradually expanding. Mr. Williams restricts it to Guadeloupe and Trinidad in North American Flora. It was later found by Mr. Paul C. Standley in the Lancetilla Valley, Honduras.[3] The locality in Guanacaste Province, Costa Rica, not only helps to outline more clearly the area in which it may be looked for but also adds another interesting species to the local flora.

CALYMPERACEAE

SYRRHOPODON GUADICHAUDII Mont.

La Fuente, 1200 m., Dec. 4, 1933, *A. Alfaro* 37.

These collections are in fine fruit and add a second locality to the Costa Rican record.

Syrrhopodon aculeo-ciliatus Bartr., sp. nov.

Figure 1.

Gracilescens, caespitosus, caespitibus laxiusculis, pallide viridibus. Caulis ad 2.5 cm. longus, basi radiculosus, dichotome ramosus vel simplex. Folia ad 2 mm. longa, sicca contorta, humida patentia, e basi vaginante auguste linearia, obtusa, limbata, limbo angusto hyalino sub apice evanido; marginibus incurvis, argute serratis, in parte superiore vaginae et summo apice dentibus aculeiformibus instructis; nervo tenui, infra apicem folii evanido, dorso scabro; cellulis laminalibus minutis rotundatis, dorso minutissime papillosis, ventri mamillosis; cancellina supra rotundata. Caetera ignota.

Dioicous? Slender plants growing in small lax tufts, pale green above, brownish below. Stems up to 2.5 cm. high, simple or forked above, sparingly radiculose near base. Leaves about 5 mm. long, flexuose, spreading, twisted and contorted when dry, widely spreading when moist, linear-lanceolate from a white, erect, narrow clasping base about 2 mm. long, gradually contracted to a linear, channelled or subtubulose point, blunt at apex, bordered from just below the apex to the base with 1-3 rows of elongate hyaline cells; margin erect or incurved, spinose-ciliate at shoulders of leaf and at apex, distantly spinose in median part of blade; costa pale and thin, about 45μ wide toward base, ending just below the apex, spinose on back toward apex, smooth below, spinose on ventral side about half-way down, in cross section near midleaf showing a median row of about 6 guide cells with stereid bands on both sides, the outer layer of cells on ventral surface well differentiated;

[3] Field Museum of Natural History, Bot. Series, 4: 352. 1929.

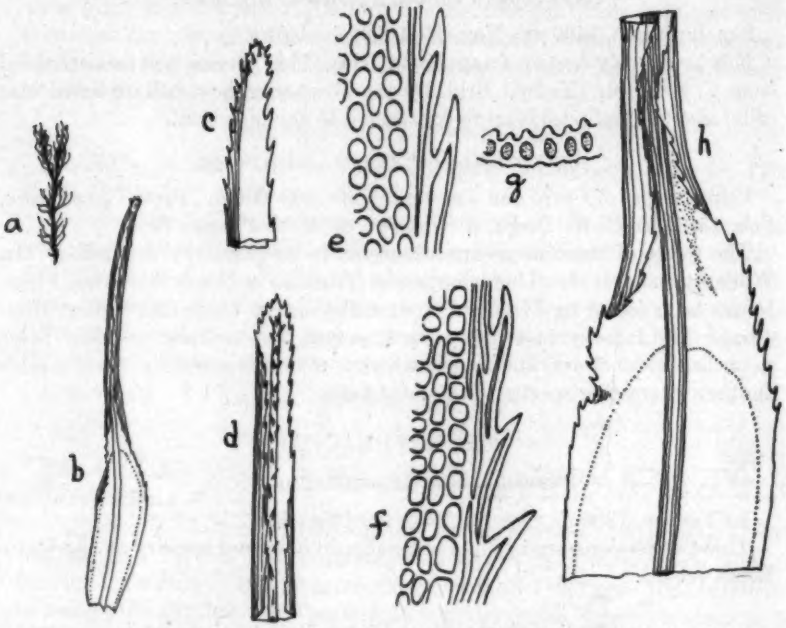

Fig. 1.—*Syrrhopodon aculeo-ciliatus* Bartr. a.—Plant ×1. b.—Leaf ×14. c.—Apex of leaf in profile ×80. d.—Apex of leaf from upper side ×80. e.—Upper leaf cells and margin ×400. f.—Cells and margin near leaf shoulder ×400. g.—Fragment of cross section from upper part of leaf ×400. h.—Part of leaf from upper side ×80.

cells of leaf blade rounded, incrassate, 6-8μ in diameter, mamillose on inner surface, minutely papillose on the back; cancellinae filling nearly all the leaf base, rounded or ending in obtuse angles above, in 8–10 rows. Sporophyte unknown.

TYPE: La Hondura, Costa Rica, August 15, 1933, *M. Valerio* 369a.

This species seems to be closely allied to *S. Leprieuri* Mont., but is noticably different in the pale green color, the mamillose leaf cells, and the spinose margins of the leaf blade.

SYRRHOPODON PARASITICUS (Sw.) Besch.

Tilarán, 700 m., March 15, 1934, *A. Alfaro.*

Even though the leaves of the Costa Rican plants seem to lack entirely the narrow hyaline border of elongated cells, they agree perfectly in other particulars with collections from Florida and Yucatán and evidently represent a form of *S. parasiticus.* The characteristic filiform propagula are abundant on the inner faces of the comal leaves.

CALYMPERES LONCHOPHYLLUM Schwaegr.

Banana River, 100 m., April 27, 1934, *F. Gutierrez.*

An interesting but not unexpected addition to the local flora which assists in consolidating the geographical range of the species. This species extends to northeastern Guatemala and British Honduras.

POTTIACEAE

HYMENOSTOMUM MEXICANUM Card.

Tiribí, 1100 m., Oct. 28, 1933, *A. Alfaro.*

LEPTODONTIUM ORCUTTI Bartr.

Potreros between Guayabillos and Cabeza de Vaca, 2150–2350 m., Prov. San José, Nov. 4, 1929, *C. W. Dodge & W. S. Thomas* 4922.

Evidently this species is confined to fairly high altitudes in Costa Rica. The only other local station known is at an altitude of 3300 m., on Volcán Irazú.

BARBULA SUBULIFOLIA Sull.

Syn.: *Barbula subulirostre* Bartr. in herbaria.

San Pedro, 1170 m., Sept. 1933, *A. Alfaro* 4, 27; Banana River, 100 m., April 27, 1934, *F. Gutierrez.*

It did not occur to me to associate these collections with *B. subulifolia* Sull. until after I had distributed several packets under the new name. Further study has convinced me that all the above collections are clearly referable to *B. subulifolia* Sull., which does not seem to have been noted in Central America before. The long subulate operculum, often appreciably longer than the urn, the long, tightly twisted peristome teeth, the subulate leaf points (usually obtuse and toothed at the apex), and the smooth quadrate leaf cells are fairly stable characters in the aggregate, but the leaves vary considerably in outline and it is probable that a number of nearly related "species" from the Antilles will eventually find their way into the synonymy of *B. subulifolia.*

BARBULA CRUGERI Sond.

Banana River, 80 m., May 20, 1934, *F. Gutierrez.*

New to Costa Rica, so far as I know. This well known and easily recognized species is common in the Antilles but apparently very rare in Central America. It appears again, like so many other Caribbean types, in the Andes of South America. The geographical distribution of these species seems to be in the form of a narrow band extending directly north and south through Colombia, western Venezuela, eastern Costa Rica, and the Greater Antilles to Cuba, with a few extensions to Florida and the northern shores of the Gulf of Mexico.

TORTULA MNIIFOLIA (Sull.) Mitt.

Banana River, 80 m., May 23, 1934, *F. Gutierrez.*

Only the second local record for this attractive species, which ranges from Cuba to Peru.

TORTULA CAROLINIANA Andrews.

San Ildefonso, 1500 m., Jan. 21, 1934, *A. Alfaro;* Volcán Barba, 2250 m., March 11, 1934, *A. Alfaro.*

In these collections the propagula are often scattered over the ventral surface of the leaf toward the apex, rather than congested in apical clusters, but in other respects the plants agree perfectly with the species.

SPLACHNACEAE

SPLACHNOBRYUM OBTUSUM C. M.

Banana River, 80 m., April 27 to May 20th, 1934, *F. Gutierrez.*

Five packets are included here in a collective sense without any great assurance that they are all representative of one specific type. The plants with leaves from 1 to 1.2 mm. long, are all more robust than *S. Bernoullii* C. M., but there is considerable variation in the length of the stems, the crenulation of the leaf margins, the relative length of the costa, and the shape of the apex.

BRYACEAE

BRACHYMENIUM STANDLEYI Bartr.

Coronado, 1500 m., Jan. 7, 1934, *A. Alfaro;* San Ildefonso, 1500 m., Jan. 21, 1934, *A. Alfaro.*

Brachymenium bulbiferum Bartr., nom. nov.

Syn.: *Brachymenium viviparum* Bartr. Cont. U. S. Nat. Herb. **26**: 77. 1928. Not *B. viviparum* Ren. & Card. 1898–99.

Fuente, 1200 m., Dec. 8, 1933, A. Alfaro.

M. Theriot has kindly called my attention to the fact that the name *B. viviparum* Bartr. is preoccupied. Unfortunately the above collection fails to show any mature fruit, although the setae are well developed. Until the peristome characters are available its systematic position must remain uncertain.

ANOMOBRYUM SEMIOVATUM (Brid.) Jaeg.

San Pedro, 1170 m., Jan. 20, 1934, *A. Alfaro* 68.

Although this species has been credited to Costa Rica this is the first local collection I have seen. Through the kindness of Mr. R. S. Williams I have been able to compare the local plants with Spruce's collection from Ecuador. They are apparently exactly alike. The percurrent or slightly excurrent costa and the relatively thin-walled upper leaf cells are characters which will

readily distinguish this species from most of its allies. It forms an interesting and suggestive link with *Bryum*.

Bryum insolitum Card. var. **brachycarpum** Bartr., var. nov.

Theca brevior, ovalis.

Tiribi, 1100 m., Oct. 28, 1933, *A. Alfaro* 21.

This unique species is a nice addition to the local list. Apart from the obviously shorter, more ovoid capsules these plants and those from Mexico seem to be identical.

BRYUM ANDICOLA Hook.

Syn.: *Bryum rosulicoma* Ren. & Card.

Cabeceras del Río Jorca, 1500 m., Oct. 22, 1933, *A. Alfaro;* Sarchi, 1980 m., Feb. 20, 1934, *A. Alfaro* 78.

There is no doubt in my mind but that this is one of the widely distributed types, similar to *Tortula fragilis* Tayl. and *Anacolia subsessilis* (Tayl.) Broth., ranging from the southwestern United States through Mexico, Central America, and western South America along the Cordilleran chain. *B. rosulicoma* Ren. & Card. and *B. rosulatum* C. M. are only two of what may prove to be an extensive list of synonyms.

BARTRAMIACEAE

PHILONOTIS UNCINATA (Schwaegr.) Brid.

La Fuente, 1200 m., Dec. 27, 1933, *A. Alfaro.*

The long setae and falcate leaves with long-excurrent costa seem to place this collection here rather than with *P. sphaericarpa.* Apparently not previously reported from Costa Rica.

ORTHOTRICHACEAE

MACROMITRIUM MEXICANUM Mitt.

Northwest slope of Cerro Carpintera, above La Unión de Tres Rios, 1320–1700 m., Prov. Cartago, Nov. 1, 1929, *C. W. Dodge & W. S. Thomas* 4789.

This appears to be the first species in the section Macrocoma to be recorded from Central America. The upper leaf cells are small, 5–7μ in diameter, as in *M. filiforme* (Hook. & Grev.), but the capsules are distinctly plicate in the upper half and the peristome teeth are not in pairs but are united in a low coarsely papillose ring extending a little above the rim, as in well-fruited plants of *M. mexicanum* collected by C. A. Purpus near Zacuapan, Vera Cruz. The agreement in peristome characters together with the crenulate leaf margins, especially in the lower half, suggests that the local collection may better be referred to *M. mexicanum.* Whether or not *M. mexicanum* is specifically distinct from *M. filiforme* is another question that may be deferred until better material of the latter is available for comparison.

MACROMITRIUM MUCRONIFOLIUM (Hook. & Grev.) Schwaegr.

Banana River, 80 m., May 20, 1934, *F. Gutierrez.*

Although not listed in any of the previous papers relating to Costa Rican mosses, this species proves to be not uncommon. I had confused it with *M. apiculatum*, without having a clear understanding of the relative distinctions between these two species as illustrated on Schwaegrichen's Plate no. 170.

MACROMITRIUM HIRTELLUM Bartr.

Tilarán, 700 m., March 15, 1934, *A. Alfaro* 110.

This species is probably only a trivial form of *M. pentastichum* C. M. The uniform arrangement of the leaves around the stem, instead of in 5 rows, is not a very tangible character. The leaves are less widely spreading when moist, and more sharply pointed, but the structural details are nearly identical.

MICROMITRIUM FRAGILE (Mitt.) Jaeg.

Santa María, Guanacaste, 825 m., Feb. 9, 1934, *A. Alfaro.*

I have been thoroughly unsuccessful in finding any characters to separate this species from *M. Schlumbergeri* Schp., and believe that the latter name can safely be relegated to synonymy.

SCHLOTHEIMIA OERSTEDIANA C. M.

Guanacaste, 825 m., Dec. 25, 1933, *A. Alfaro* 50; Potreros near farmhouse at Hacienda Santa María and source of Río Liberia, Prov. Guanacaste, Jan. 21–24, 1930, *C. W. Dodge & W. S. Thomas* 6944, 6958, 6967; Roadside north of Tilarán, Prov. Guanacaste, Pacific slope, 500–690 m., Feb. 20, 1930, *C. W. Dodge & W. S. Thomas* 6579; Volcán de Barba, 1800 m., 1931, *Ruben Torres* 145.

These collections have not been referred here without considerable distrust. I have not succeeded in finding the narrowly lanceolate-acuminate inner perichaetial leaves described by Müller, but on the other hand the only inference I can draw from a careful comparison of a considerable series of specimens from southern United States, eastern Mexico, British Honduras, and Guatemala is that *S. Sullivantii* C. M., *S. Oerstediana* C. M., *S. Mohriana* C. M. and *S. Sartorii* C. M. are in reality only minor variants of one specific type. In this group the perichaetial leaves are only slightly longer than the stem leaves, longitudinally plicate, either smooth or transversely wrinkled in the upper half, and either mucronate or short-acuminate at the apex. As the differences are too slight and unstable to separate the forms clearly, I strongly suspect that *S. Sullivantii* C. M. may be used in an inclusive sense to cover the plants ranging from the southern United States to Costa Rica. A comparative study of the respective types is essential before any definite conclusion can be made.

CRYPHAEACEAE

ACROCRYPHAEA GARDNERI (Mitt.) Jaeg.

San Ildefonso, 1500 m., Jan. 21, 1934, *A. Alfaro;* Banana River, 80 m., May 17, 1934, *F. Gutierrez.*

The strongly reflexed leaf margins definitely associate these collections with *A. Gardneri* rather than *A. julacea* (Hornsch.). I know of no previous record of *A. Gardneri* from north of Colombia.

LEUCODONTACEAE

LEUCODONTOPSIS FLORIDANA (Aust.) E. G. Britt.

Laurel, Banana River, 100 m., May 2, 1934, *F. Gutierrez.*

This is the first collection of this species I have seen from Costa Rica, although it has been credited to the local flora.

METEORIACEAE

Squamidium crispipilum Bartr., sp. nov.

Figure 2.

Dioicum? Sat robustum, superne lutescenti-viride, intus fuscescens, nitidum. Caules elongati, penduli, inordinate et brevissime pinnatim ramosi.

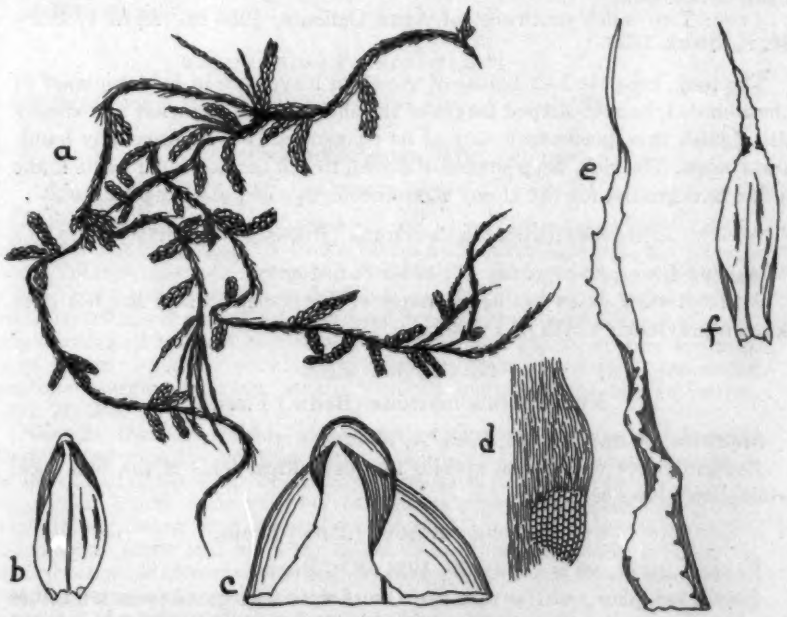

Fig. 2.—*Squamidium crispipilum* Bartr. a.—Part of plant ×1. b.—Branch leaf ×16. c.—Apex of branch leaf ×80. d.—Basal angle of branch leaf ×80. e.—Apex of stem leaf ×80. f.—Stem leaf ×16.

Folia dimorpha, caulina ovato-lanceolata, appressa, apice in acumen elongatum flexuosum canaliculatum argute serratum producta; nervo tenui, supra medium producto; cellulis linearibus, laevibus, ad angulos pluribus quadratis; ramulina ovalia, valde concava, apice galeata, nervo angusto sub apice evanido. Caetera ignota.

Dioicous? Rather robust plants growing in intricate masses, pale yellowish green at the tips, brown or blackish below, glossy. Stems long, flexuose, tangled, ending in slender flagellaceous tips; branches short, distant, blunt, sometimes in clusters. Stem leaves and branch leaves strongly differentiated. Stem leaves about 3.5 mm. long, erect or slightly spreading, concave, ovate-lanceolate, abruptly narrowed to a flexuose, crisped point, this slightly shorter than the leaf blade; margins erect, entire below, coarsely toothed from the base of the acumen to the apex, irregularly inflexed in the acumen; costa single, faint, ending about two-thirds up; leaf cells linear, 3–4μ wide by 12 to 16 times as long, shorter in several rows across the insertion with sinuose, pellucid lateral walls; alar cells numerous, sharply differentiated, short-rectangular, yellowish, in 8 or 9 rows, extending about half-way to the costa; branch leaves closely imbricated, strongly concave, indistinctly seriate, ovate, about 1.8–2 mm. long, contracted just below the rounded galeate apex; costa ending below the apex; margin erect, entire or very faintly denticulate above; leaf cells short and irregular at the extreme apex with pellucid, slightly pitted lateral walls, otherwise as in the stem leaves. Fruit unknown.

TYPE: Two miles southwest of Agua Caliente, 1050 m., April 1, 1928, H. E. Stork 1338.

The long, crispate hair points of the stem leaves are in bold contrast to the rounded, helmet-shaped leaves of the short lateral branches and clearly distinguish this species from any of its congeners. It is an unusually handsome moss. The rich, deep shades of brown in the tangled older parts make a fine background for the glossy stramineous tips of the younger growth.

METEORIOPSIS RECURVIFOLIA (Hornsch.) Broth.

Banana River, 80 m., May 17, 1934, *F. Gutierrez.*

An interesting extension in the range of this species, which has not been known previously north of Panama.

NECKERACEAE

NECKEROPSIS DISTICHA (Hedw.) Fleisch.

Siquirres, 60 m., Dec. 23, 1933, *A. Alfaro.*

Evidently not a common species in Costa Rica. This is the first local collection I have seen.

PINNATELLA MINUTA (Mitt.) Broth.

Banana River, 80 m., May 20, 1934, *F. Gutierrez.*

Only a few plants of this rare little moss were segregated from a mixture of other species, but the leaf characters are so obviously distinct from anything else in the region that its identity is almost certain. I doubt if it has ever been re-collected since the original gathering by Wright in Cuba.

HOOKERIACEAE

DALTONIA TENUIFOLIA Mitt.

Coronado, 1400 m., Dec. 17, 1933, *A. Alfaro;* Cabeceras del Río Jorco, 1500 m., Oct. 22, 1933, *A. Alfaro.*

Both of these collections are in good fruit and are interesting local records for a rare species.

CROSSOMITRIUM OERSTEDIANUM C. M.

Banana River, 80 m., May 4, 1934, *F. Gutierrez.*

I have not seen the type, but the above collection agrees perfectly with Müller's description of this species. The very flat stems, closely appressed to the substratum with the leaves scarcely shrivelled when dry, give the plants the appearance of an hepatic. The lateral leaves are suborbicular, with a very short, blunt, oblique point, and show the characteristic paired teeth on the upper margins. The general aspect of the plants is very different from that of the group with arcuate, sharply pointed leaves, shrivelled when dry, which Brotherus groups in the section Phyllophila and to which the following species belongs. A critical study of the species of this strictly American genus is badly needed.

CROSSOMITRIUM PATRISIAE (Brid.) C. M.

Laurel, Banana River, 100 m., May 2, 1934, *F. Gutierrez.*

Lepidopilum apiculatum Bartr., sp. nov.

Figure 3.

Dioicum, nitide lutescenti-viride. Caulis secondarius ascendens, complanatus, 2–3 cm. longus, circa 4 mm. latus. Folia sicca contorta, vix plicata, ovato-oblonga, abrupte breviterque apiculata, 2 mm. longa; marginibus anguste revolutis, superne planis minute denticulatis; nervis supra medium evanidis; cellulis superioribus rhombeis, marginalibus uniseriatis angustioribus, basilaribus longioribus; capsula in pedicello superne scabro 6–8 mm. longo erecta; operculo subulato-rostrato; calyptra ramentosa; peristomii dentibus margine sinuosis, strato ventrali angustissimo; sporae laeves, diam. 20–25μ.

Dioicous, densely tufted, glossy yellowish green plants. Antheridial plants mixed with the fruiting stems. Male buds 1.5 mm. long, axillary on the lower half of the stem. Secondary stems ascending, complanate, 2–3 cm. long, about 4 mm. wide with leaves. Leaves slightly contorted when dry, ovate-oblong, 2 mm. long, abruptly contracted to a short, half-twisted apiculus; margins plane and minutely denticulate above, narrowly revolute on one or both sides below; costae slightly divergent, ending above the middle; upper leaf cells oval and rhomboidal, 10–15μ wide, with firm, yellowish walls, one row at the margins linear, forming a very narrow inconspicuous border; basal cells more elongate, linear-rhomboidal. Seta 6–8 mm. long, flexuose, scabrous above, smooth below; capsule erect, ovoid-cylindrical; lid subulate-rostrate; calyptra sparingly ramentose; peristome teeth sinuose on the mar-

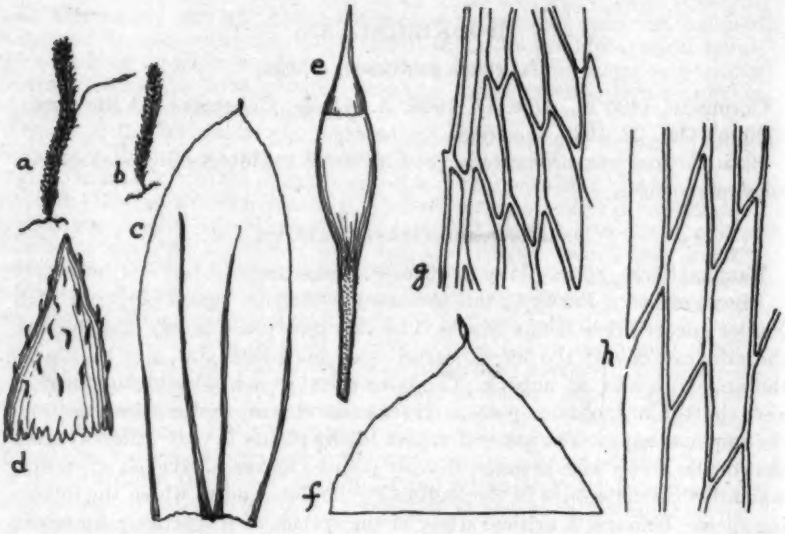

Fig. 3.—*Lepidopilum apiculatum* Bartr. a.—Fruiting plant ×1. b.—Antheridial plant ×1. c.—Lateral leaf ×35. d.—Calyptra ×12. e.—Capsule and upper part of seta ×12. f.—Tip of leaf ×80. g.—Upper leaf cells and margin ×400. h.—Basal leaf cells and margin ×400.

gins, the outer plates much wider than the inner layer; spores brownish, smooth. 20–25μ in diameter.

TYPE: Banana River 80 m., *F. Gutierrez.*

This species is probably nearest *L. cubense* Sull., but is clearly distinguished by the more broadly pointed leaves (which are abruptly contracted to a short, partly twisted apiculus), the longer costae extending well above the middle of the leaf, the minutely and distantly denticulate upper margins, and the narrower basal cells, which are not as lax as in *L. cubense.*

THUDIACEAE

THUIDIUM INVOLVENS (Hedw.) Mitt.

Banana River, 80 m., May 4, 1934, *F. Gutierrez.*

BRACHYTHECIACEAE

BRACHYTHECIUM STEREOPOMA (Spr.) Jaeg.

Coronado, 1400 m., Dec. 17, 1933, *A. Alfaro;* Alajuelita, 1600 m., Dec. 18, 1933, *A. Alfaro* 33; San Ildefonso, 1500 m., Jan. 21, 1934, *A. Alfaro;* Moravia, 1300 m., Feb. 11, 1934, *A. Alfaro.*

The authors indicate that *B. costaricense* Ren. & Card. may be easily distinguished from *B. stereopoma* by the leaves strongly excavate at the base on each side of the nerve and by the more robust branches. These differences

are not at all well defined when a broad series of specimens is compared, and I am unable to find any stable characters by means of which the two species may be clearly separated. Like all widely distributed species *B. stereopoma* is variable within reasonable limits, but I doubt if these varations can be correlated with any distinct specific concepts.

ERIODON RADICALIS Spruce

Asserí, 1400 m., Feb. 4, 1934, *A. Alfaro.*

This is an unusually interesting collection and, so far as I know, the first time the species has been discovered since Spruce's original collection in Ecuador. The Costa Rican plants are identical with those from Ecuador and add a new genus to the North American moss flora.

ENTODONTACEAE

ERYTHRODONTIUM SQUARROSUM (C. M.) Par.

Guadalupe, 1200 m., Dec. 2, 1933, *A. Alfaro.*

CAMPYLODONTIUM ONUSTUM (Hpe.) Jaeg.

Pejivalle, 600 m., Sept. 30, 1933, *A. Alfaro.*

The above collection is identical with authentic specimens from Colombia and Venezuela. Apparently it is the first record of the species in North America.

ENTODON BEYRICHII (Schwaegr.) C. M.

Asserí, 1400 m., Feb. 4, 1934, *A. Alfaro;* Alajuelita, 1380 m., Jan. 20, 1934, *A. Alfaro;* Jorco, 1200 m., Oct. 21, 1933, *A. Alfaro;* Tiribí, 1100 m., Oct. 28, 1933, *A. Alfaro.*

This species has a wider distribution than Brotherus indicates. It has been collected in Jamaica and Haiti, and apparently the specimens from Costa Rica recorded in my previous papers under the names of *E. erythropus* Mitt. and *E. Bernoullii* C. M. are all referable here. There is nothing in the description of *E. Bernoullii* C. M. to distinguish it from *E. Beyrichii* and I suspect that it should be reduced to a synonym of this species.

PLAGIOTHECIACEAE

STEREOPHYLLUM RADICULOSUM (Hook.) Mitt.

Santa María, Prov. Guanacaste, 825 m., Dec. 25, 1933, *A. Alfaro.*

Although this species does not seem to have been reported from Costa Rica before, it is not an unexpected addition to the local flora. The leaf cells are often clearly unipapillate on the back, rather than consistently smooth as indicated by Brotherus.

SEMATOPHYLLACEAE

PTEROGONIDIUM PULCHELLUM (Hook.) C. M.

Banana River, 80 m., May 4, 1934, *F. Gutierrez.*

The only local record that I know of for this delicate little species.

HYPNACEAE

ISOPTERYGIUM SUBTRICHOPELMA Ren. & Card.

La Fuente, 1200 m., Dec. 8, 1933, *A. Alfaro;* Cabaceras del Río Jorco, 1500 m., Oct. 22, 1933, *A. Alfaro.*

It seems very doubtful if this species is anything more than one of the variants of *I. tenerum* (Sw.) Mitt.

TAXIPHYLLUM PLANISSIMUM (Mitt.) Broth.

Asserí, 1400 m., Feb. 4, 1934, *A. Alfaro.*

Another interesting but not unexpected addition to the local list, the species having been known previously from Mexico, the West Indies, and Ecuador.

VESICULARIA CRASSICAULIS (Mitt.) Broth.

Banana River, 80 m., May 20, 1934, *F. Gutierrez.*

The slenderly acuminate, falcate-secund leaves clearly separate these plants from both *V. amphibola* and *V. vesiculare.* It extends the range of the species considerably to the southward and is a fine addition to the local flora.

BOTANY.—*Two new grasses, one from Tennessee, one from Argentina*[1]

A. S. HITCHCOCK, Bureau of Plant Industry.

Recently Mr. Stanley A. Cain, of the Indiana Academy of Sciences, Bloomington, Indiana, sent to me a specimen of an apparently new grass which he had collected in the mountains of eastern Tennessee. This proved to be a new species of *Calamagrostis,* allied to *C. porteri* A. Gray and *C. perplexa* Scribn.

About the same time I received from Dr. F. C. Hoehne, of the Instituto Biologico, São Paulo, Brazil, a dwarf grass collected by Dr. A. Burkart in the high mountains of the Province of Tucumán, Argentina. This also proved to be undescribed. It is one of the smallest species of the genus *Catabrosa,* of which there are a few in southern South America. The genus is represented in the United States and northern Eurasia by *C. aquatica* (L.) Beauv., a relatively large widely distributed species, found in mountain meadows, bogs, and wet places.

Calamagrostis cainii Hitchc., sp. nov.

Perennis, dense caespitosa, rhizomatibus brevibus; culmi graciles, erecti, infra paniculam scabri, 30–40 cm. alti; vaginae glabrae; ligula 1–2 mm. longa; laminae planae, longe acuminatae, infra glabrae, supra scabrae, 20–35 cm. longae, 1–2 mm. latae, suprema 5–10 cm. longa; panicula pauciflora, pat-

[1] Received September 21, 1934.

ula, pallida, 6–10 cm. longa, axi scabro, ramis 1–2 cm. longis; glumae angustae, acuminatae, 5–6 mm. longae; lemma acuminatum, pilis calli 1–2 mm. longis, infra medium aristatum, arista medio geniculata, inferne torta, glumas paullum excedente; processus rachillae brevis, villis 1–2 mm. longis.

Perennial, densely cespitose, with short rhizomes; culms slender, erect, scabrous below panicle, 30–40 cm. tall; sheaths glabrous; ligule of culm leaves thin, rounded or obtuse, finely dentate, becoming lacerate, 1–2 mm. long; blades erect, flat, more or less involute toward the finely attenuate tip, glabrous beneath, scaberulous on the upper surface, narrowed toward base, the basal ones as much as 35 cm. long, 1–2 mm. wide, the uppermost culm blade 5–10 cm. long, about 1 mm. wide; panicle pale or whitish, loose, 6–10 cm. long, the axis scabrous, the branches ascending or somewhat spreading, verticillate, scabrous, 1–2 cm. long, bearing 1–few spikelets, the whorls 7–15 mm. apart, the pedicels scabrous-pubescent; glumes narrow, nearly equal, acuminate or slightly aristate, glabrous except the scabrous upper half of the keels, 5–6 mm. long, the first 1-nerved, the second 3-nerved; lemma narrow, acuminate, 5-nerved, glabrous below, minutely scaberulous near the finely toothed summit, the callus hairs about 1 mm. long, the awn about 1 mm. from base, somewhat geniculate, twisted below, the tip bent to one side and somewhat exceeding the glumes; palea a little shorter than the lemma; prolongation of the rachilla very short but the hairs 1–2 mm. long.

Type in the U. S. National Herbarium, no. 1,611,706, collected on the shrubby summit of Mt. LeConte, Tennessee, alt. about 2000 meters, August 10, 1929, by *Stanley A. Cain* (no. 48). Later Mr. Cain sent specimens (no. 1016) from the same locality, with the statement that the species grew abundantly on cliffs in spruce-fir formation.

Catabrosa Burkartii Hitchc., sp. nov.

Perennis, pusilla; culmi caespitosi, erecti, 1–3 cm. alti; vaginae glabrae; ligula 1–2 mm. longa; laminae planae vel plerumque complicatae, glabrae, graciles, 5–20 mm. longae; panicula angusta, pauciflora, 5–8 mm. longa; spiculae 3–4 mm. longae, 2-flores, glabrae; lemmata oblonga, obtusa, circa 3 mm. longa.

Dwarf cespitose perennial; culms glabrous, erect, 1–3 cm. tall; sheaths glabrous, striate-nerved, rather loose, the uppermost somewhat inflated; ligule thin, 1–2 mm. long; blades mostly folded, rather firm, somewhat falcate, glabrous, 5–20 mm. long, about 0.3 mm. thick as folded, the rounded or boat-shaped tip cartilaginous, the lower blades sometimes flat and 1 mm. wide; panicle narrow, 5–8 mm. long bearing a few yellowish short-pediceled spikelets, the branches slightly scabrous on the angles; spikelets 3–4 mm. long, 2-flowered; glumes about equal, broad, rather obscurely nerved, glabrous, rounded at the somewhat erose tip, 2.5–3 mm. long; lemmas glabrous, the first oblong, obtuse, a little more than 3 mm. long, the upper part with a yellowish zone below the rounded minutely erose summit, the palea narrow, shorter than the lemma; second lemma similar to the first but slightly shorter, the summit about as high as that of the first, the internode of the rachilla between the florets being very short.

Type in the U. S. National Herbarium, no. 1,539,407, collected on the summit of Calchaquíes, Dept. Taff (Prov. Tucumán), Argentina, alt. 4200 meters, January 30, 1933, by *A. Burkart* (no. 5348). Part of the type in the herbarium of the Instituto Biologico, São Paulo, Brazil.

PALEOBOTANY.—*Three additions to the Pleistocene flora of Tennessee.*[1] EDWARD W. BERRY, The Johns Hopkins University.

In the fall of 1931 Walter F. Pond, State Geologist of Tennessee, sent me some samples of impure lignite encountered in a well 5 miles east of Dayton in that state. The country rock is Knox dolomite and it seems probable that the silty lignite was formed in a sink in the dolomite. The age of the lignitic deposit is a matter of considerable interest. Fortunately I am now able to determine the age with considerable certainty. On one specimen of the lignitic clay there is an excellent impression of two-thirds of a leaf which after extensive comparison with recent material I am convinced is a leaf of the existing button-bush, honey-ball, or globe-flower, *Cephalanthus occidentalis* Linné, a shrub of swamps and low ground, ranging from eastern Canada to Mexico, and common in the Tennessee region. This means that the lignite is Pleistocene in age.

Interestingly enough *Cephalanthus occidentalis* has been reported by Auer (1930, p. 31) from the peat of Marsh Hill and Welland in southeastern Canada. Other than this the genus has never been reported as a fossil, although the 6 existing species are found in eastern Asia, North and South America, and West Africa, and this distribution is fair evidence that the genus has a Tertiary history.

In March, 1933, I received from E. L. Spain, Jr., of Vanderbilt University, a small amount of clay underlying a peaty layer in terrace deposits on a tributary of the Cumberland River, central Stewart County.

This clay was silty and broke down readily in water, and was found to contain characteristic fragments of *Quercus alba* Linné and *Quercus imbricaria* Michaux.

Quercus alba has been recorded from Ontario Interglacial deposits,[2] from the Port Kennedy cave in Pennsylvania,[3] from the Chowan formation of North Carolina,[4] from Buena Vista, Virginia,[5] from post Pleistocene deposits in Massachusetts,[6] and is probably represented in the Sunderland formation of Maryland by what Hollick called *Quercus pseudoalba.*[7] It ranges in the recent flora from Maine, Ontario and Minnesota to Florida and Texas.

[1] Received August 20, 1934.
[2] PENHALLOW, D. P. Amer. Nat. 41: 448. 1907.
[3] MERCER, H. C. Jour. Acad. Nat. Sci. Phila. 11: 281. 1899.
[4] BERRY, E. W. Jour. Geol. 15: 342. 1907.
[5] BERRY, E. W. Am. Jour. Sci. 34: 221. 1912.
[6] EMERSON, B. K. U. S. Geol. Surv. Bull. 597: 148. 1917.
[7] HOLLICK, A. Md. Geol. Surv. Pliocene & Pleistocene, p. 227, *pl. 70, fig. 2, pl. 71, figs. 1–6.* 1906.

Quercus imbricaria has been recorded from Bridgeton, N. J. by Lesquereux[8] from beds which I consider as probably Pleistocene in age, although they have usually been considered somewhat older. In the recent flora it ranges from Pennsylvania to Michigan and Arkansas, Georgia and Tennessee.

[8] LESQUEREUX, L. U. S. Nat. Mus. Proc. 10: 39. 1887.

ZOOLOGY.—*New experimental hosts for* Brachylaemus virginiana (*Dickerson*) *Krull.*[1] WENDELL H. KRULL, Bureau of Animal Industry.

The white rat, dog, cat, and chicken have been infected experimentally with *Brachylaemus virginiana*, a fluke normally parasitic in the opossum, *Didelphis virginiana*, and mature flukes have been recovered from these hosts. Eggs of *B. virginiana* collected from the feces of one of the experimentally infected dogs were used to infect the normal first intermediate host, *Polygyra thyroides*. Consequently, it is assumed that some, at least, of the new hosts are potentially capable of disseminating the parasite in regions where the opossum and its snail host are found.

The metacercariae of *B. virginiana* used in the following infection experiments were obtained from laboratory raised and infected snails, *P. thyroides;* an extensive account of these infection experiments is being given by the writer in a paper now in press. Every snail used in the subsequent experiment contained hundreds of metacercariae, all of which were 7 months old.

Two puppies, litter mates, were used in the present experiment. A puppy 5 weeks old was given approximately 200 metacercariae, and when it was killed, 7 days later, 111 mature specimens of *Brachylaemus virginiana*, 2.05 to 2.60 mm. long when stained and mounted, were recovered from the intestine. The uterus in each of these flukes was extensive and filled with apparently normal, brown colored eggs. The second puppy, when 6 weeks old, was given approximately 400 metacercariae. Eggs were recovered in the feces of the dog 12 days after the metacercariae were administered; eggs were quite common in the feces a day later, abundant 5 days after that, and fewer in number 9 days later, or 27 days after the dog was infected. Since there was an apparent decrease in the number of eggs it was suspected that the infection was being lost; however, when the animal was killed 349 flukes were recovered. These were large and equal in size to any

[1] Received August 24, 1934.

recovered from an opossum. The trematodes were localized in a comparatively small area in the posterior part of the small intestine. They were very conspicuous because of the numerous dark colored eggs in the extensive uterus which occupies the greater part of the intercecal field. On 3 previous occasions metacercariae of *B. virginiana* have been given to adult dogs and no infections ever developed, and, while not enough dogs were used for the results to be significant, the experiment indicates that adult dogs apparently are not easily infected.

Eggs of *Brachylaemus virginiana* from the feces of the second puppy in the present experiment were used to infect the normal first intermediate host, *Polygyra thyroides*. Four snails were subjected to infection, and 2 of them became infested.

Two kittens, litter mates, were used in infection experiments. A suckling kitten, 2 weeks old, was given approximately 100 metacercariae and when it was examined postmortem, 7 days later, 74 mature flukes, 1.95 to 2.25 mm. long when stained and mounted, were recovered. The uterus in each fluke was extensive and filled with normal brown colored eggs. A second kitten, 3 weeks old, was given about 200 metacercariae, and eggs of the fluke appeared in the feces 14 days later. Eggs were common in the feces of the host 3 days later, and fewer after 10 more days, or 27 days subsequent to the time the animal was subjected to infection. The kitten was weaned while it was infested and when examined postmortem, 27 days after receiving the metacercariae, 50 adult flukes were recovered; they were in the posterior part of the small intestine, as in the case of the dog.

Two chicks were used in infection experiments; these were less than 24 hours old when subjected to infection. One chick was given 50 metacercariae, and when destroyed, 2 days later, 5 immature flukes were recovered from the posterior part of the small intestine. These flukes had grown considerably and had attained adult shape. The other chick received 75 metacercariae and 5 days later 6 mature flukes, 1.95 to 2.35 mm. long when stained and mounted, were recovered postmortem from the intestine. All flukes had normal colored eggs in the terminal part of the descending branch of the uterus.

On previous occasions attempts to infect 4 chickens with *B. virginiana* had been unsuccessful. These chickens were fully feathered at the time they were subjected to infection. Since the cause of the failure to infect these chickens is not known, and since the diet may have had something to do with the negative results, it should be stated that these chickens were fed on grain, while the chicks which

became infested in the present experiment were given bits of raw beef.

A small rat, which had just been weaned, was given 75 metacercariae, and when examined, 3 days later, 2 mature flukes, each containing a couple of eggs were recovered from the small intestine. A second rat, fully grown, received approximately 100 metacercariae, and when killed 4 days later, 5 mature flukes were recovered postmortem from the small intestine. The flukes from this rat contained numerous normally colored eggs.

Previously it was found by the writer that *Brachylaemus virginiana* would live in the white rat only 3 days. In view of the small number of parasites recovered from the rats in the present experiment, in spite of the comparatively large numbers of metacercariae which were administered, it is suspected that previous failure to obtain adult flukes in white rats resulted from using too few metacercariae in attempts to infect them.

SUMMARY AND CONCLUSIONS

The experiment shows that the dog, cat, chicken, and white rat may serve as definitive hosts of *Brachylaemus virginiana* of which the opossum is the natural definitive host. It is apparent from the data presented that there may be a difference in the rate of maturity and growth after maturity of the flukes in the different hosts. More data, however, are necessary to verify this point. A comparison of flukes of the same age from a kitten and a puppy, however, showed a striking difference in size, the flukes in the puppy being larger than those in the kitten. Young dogs and cats become infected easily, and practically all of the metacercariae establish themselves, which fact is not apparent in the case of chickens and rats.

The results of these experiments suggest that some of the described species in this genus, which are morphologically similar, are not good species, but have been recognized as valid largely because of host relationship. It is also apparent that, since *B. virginiana* has been established in several hosts, it may be a suitable trematode with which experiments relative to age resistance, longevity, and the relation of the fluke to food habits of the host may be undertaken.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

GEOLOGICAL SOCIETY

510TH MEETING

The 510th meeting of the Society was held in the Assembly Hall of the Cosmos Club, Jan. 10, 1934, President H. G. FERGUSON presiding.

Program: LAWRENCE MARTIN: *A standard map of the maxima of Pleistocene glaciation in North America.* Discussed by Messrs. MATTHES and CAPPS.

W. G. HOYT: *Forests and stream flow.*—Following the deforestation (removal of trees by cutting) of a high mountain area in the vicinity of Wagon Wheel Gap, Colorado, the average annual run-off of the deforested area was increased 15 percent, the maximum peak discharge was increased 46 percent, and the summer and fall run-off was increased 12 percent.

Following the denudation (destruction by fire of all ground cover and tree litter) of a coastal mountain drainage basin in southern California, the average annual run-off of a denuded area was increased 29 percent. The maximum peak discharge of the first four floods following denudation was increased about 1,700 percent, and the summer and fall run-off was increased 475 percent.

The increase in the annual run-off was distributed rather uniformly throughout the year, 52 percent of the increase from both areas occurring during periods of non-flood run-off and 48 percent during periods of flood run-off.

In the Colorado area there was practically no evidence of erosion after deforestation and this was to be expected because there was little direct surface run-off either before or after deforestation. In the southern California area complete denudation increased erosion as a direct result of increased surface run-off and deposition of eroded material and ash carried by the stream the first year after the fire was materially injurious to agricultural lands and transportation rights of way.

Conclusive evidence showed that on these two areas (1) forests and brush cover substantially lower stream flow at practically all seasons and all stages, including flood, minimum and total flow; (2) forests and brush cover substantially lessen erosion where readily eroded material is available, and (3) new vegetative growth exercises an effect similar to the original cover in retarding erosion, but without so detrimental an effect on annual run-off and summer low-water flow.

In watershed protection studies it is therefore necessary to determine the type of cover which will best protect the soil, minimize the water losses and provide for the most economical use of the watershed area and of the water yield. The cover may be forests or other plant species depending on the soil, topography, climate, and nature and amount of water supply requirements of the dependent region. (*Author's abstract.*) Discussed by Messrs. FERGUSON, BRIDGE, COOKE, MENDENHALL, TRASK, BRADLEY, SPENCER, RUBEY, MERTIE, and THOMPSON.

E. T. MCKNIGHT: *Origin of zinc and lead deposits of northern Arkansas.* Discussed by Messrs. FERGUSON, TRASK, BRIDGE, GOLDMAN, SPENCER, BRADLEY, HENBEST, and RUBEY.

511TH MEETING

The 511th meeting of the Society was held in the Assembly Hall of the Cosmos Club, Jan. 24, 1934, President H. G. FERGUSON presiding.

Informal communication. R. W. BROWN exhibited a specimen from Peru, described by F. H. Knowlton as *Zea antiqua*, a supposed new species of fossil corn. Restudy of the specimen by means of thin sections showed it to be baked pottery.

D. F. HEWETT called attention to the analyses of the wall rocks of Virginia caves listed on page 143 of W. M. McGill's *Caverns of Virginia*. Of samples from 13 developed caves, 6 contain less than 1 percent $MgCO_3$; 3 contain between 1 and 3 percent; 3 contain between 5 and 14 percent; and one contains 30 percent of $MgCO_3$. The predominant non-dolomitic character of the cave-forming rocks lends strength to the hypothesis that the dolomitic zinc-bearing breccias of the Appalachians are of tectonic origin. Discussed by Messrs. KEITH, BUTTS, and BEVAN.

M. I. GOLDMAN reviewed a recent monograph on fossil Protozoa by OTTO WETZEL entitled *Die in organischer Substanz erhaltenen Mikrofossilien des Baltischen Kreide-Feuersteins mit einem sedimentpetrographischen und stratigraphischen Anhang* which appeared in 1933 as vol. 78, part A of Paleontographica. He showed slides of two of the plates illustrating flagellate and radiolarian-like organisms. GOLDMAN also called attention to an early paper by M. C. WHITE, appearing in the American Journal of Science in 1862, which described similar forms. Discussed by Messrs. RESSER and HESS.

Program: C. LEWIS GAZIN: *A marsupial from the Florissant beds of Colorado.*—In 1929 the U. S. National Museum purchased from G. F. Sternberg fossil remains of a mammal collected by him in the Florissant beds of Colorado. These beds, renowned for their fossil flora and insect fauna, have heretofore produced no identifiable mammalian remains, although a few birds and fish have been described. The didelphid mammal discovered in the Florissant beds apparently represents the extinct genus *Peratherium*, a small marsupial resembling the murine opossum *Marmosa* now living in southern Mexico, Central and South America. *Peratherium* is known in the Tertiary of North America in several stages from the Fort Union Paleocene to the middle John Day horizon of upper Oligocene or lower Miocene age, but has never been recorded from later beds in this country. Of the various forms described the Florissant specimen seems to correspond most closely to the species *Peratherium huntii* from the Cedar Creek beds of Oligocene age in northeastern Colorado.

On the basis of the known distribution of *Peratherium* it is suggested that the Florissant beds may be of earlier age than the upper Miocene stage currently assigned to them. From the similarity between the Florissant *Peratherium* and *P. huntii* it is further suggested, but not certainly demonstrated, that the age is Oligocene. (*Author's abstract.*) Discussed by Mr. LOVERING.

C. R. LONGWELL: *Some structural problems in central Connecticut and Massachusetts.* Discussed by Miss JONAS and Messrs. STOSE, GOLDMAN, G. O. SMITH, MENDENHALL, LOVERING, and BOWIE.

512TH MEETING

The 512th meeting of the Society was held in the Assembly Hall of the Cosmos Club, Feb. 14, 1934, President H. G. FERGUSON presiding.

Informal communications: T. A. HENDRICKS exhibited and discussed

specimens of rolled siltstone from Pennsylvanian strata of the Oklahoma Coal fields. Discussed by G. A. COOPER.

R. B. STEWART reviewed critically Bucher's *Deformation of the Earth's Crust.* Discussed by W. W. RUBEY.

Program: L. K. WENZEL: *Thiem's method of determining permeability and pumping-test method of determining specific yield of water-bearing materials.*—A pumping test was made in the summer of 1931 near Grand Island, Nebraska, to determine the usefulness of Thiem's method for determining permeability and the pumping-test method for determining specific yield. An irrigation well was pumped continuously for 48 hours during which time the drawdown of the water table was measured in 81 observation wells spaced from 2 to 1,200 feet from the pumped well. Data were also obtained on the discharge of the pumped well, the thickness of the water-bearing formation, and the normal slope of the water table.

It was found that the coefficients of permeability computed by Thiem's formula, instead of being constant, varied through a wide range because the conditions observed in the field did not correspond to the theoretical conditions assumed in the development of the formula. However, a constant and accurate value of the permeability of the material was finally obtained by substituting in Thiem's formula only the drawdown of the water table where the cone of depression had reached approximate equilibrium in form—from about 50 to 200 feet from the pumped well. This procedure was adopted because Thiem's formula is based on the assumption that the cone of depression has attained an equilibrium condition. Certain other modifications in the use of the method were made which resulted in a more accurate determination of the true permeability. It is now thought that this method is the best method for determining permeability.

The specific yield of the water-bearing material was obtained by applying Darcy's law to the flow of water through concentric cylindrical cross-sections of material around the pumped well. The values of specific yield increased with the period of pumping because all of the water did not immediately drain out of the unwatered material. A final value for the specific yield was obtained by plotting the values of specific yield against the period of pumping and by extending the curve drawn through these points. The final value compared closely with the specific yield obtained by laboratory analyses of samples of the material. (*Author's abstract.*) Discussed by Messrs. THOMPSON, MEINZER, FERGUSON, and LEGGETTE.

T. B. NOLAN: *The geyser area near Beowawe, Nevada* (by title).

E. N. GODDARD: *The relation of Tertiary intrusives to ore deposits of Jamestown, Colorado.*—In the Jamestown mining district, in the Colorado Front Range 35 miles northwest of Denver, there are two Tertiary (Eocene?) stocks and numerous dikes that seem to have a genetic relation to the ore deposits. These Tertiary "porphyries" have been intruded into a pre-Cambrian complex of schist and granite. The earliest is a large approximately rectangular stock (about 1½ by 2½ miles) of hornblende granodiorite, having a N. 12° E. trend. On its north border is a small stock (about three quarters of a mile in diameter) of quartz monzonite porphyry, and to the east of these stocks are northeast dikes of quartz monzonite, bostonite, and alaskite porphyry. These porphyries were intruded after the greater part of the regional deformation of the Laramide revolution had taken place.

In the district there are two systems of post-porphyry fault fissures that are occupied by the ore deposits; a northwest system (in general, the earlier)

and a northeast system. The northwest system comprises breccia zones and veins that are confined to a narrow belt on the southwest border of the quartz monzonite stock. The northeast system consists of N. 60–70° E. fissures, and is largely confined to the east sides of the stocks.

The ore deposits show a rough zonal arrangement around the quartz monzonite stock. Fluorspar, the earliest of the ore deposits, occurs in the northwest system of fractures and breccia zones close to the southwest border of the stock. Lead-silver deposits occur in pipes or veins in or near fluorspar deposits in a small area of about a half square mile on the west side of the stock. Pyritic gold veins occupy the northeast fault fissures 1 to 2 miles east of the stock. Gold telluride veins occupy northeast fault fissures 2 to 2½ miles east of the stock, and a few ½ to 1 mile west of the stock. This description shows an unsymmetrical and rather irregular arrangement of the ores around the quartz monzonite stock.

In an attempt to account for this irregular distribution of the ores, the Cloos' method of mapping the internal structures of igneous masses was applied to the porphyry bodies. In the large granodiorite stock the platy and linear structures indicate a roughly elliptical cylindrical mass which pitches 60 to 70° south-southwest. During its emplacement, it probably moved upward in a N. 15° E. direction at an angle of about 65°. The magma apparently came up along a fracture-like opening and widened its channel by pushing outward in a S. 75° E. direction against a weak zone of granite and schist. In response to this force, the rocks tended to break at angles of slightly less than 45° to the direction of force. Both N. 65° E. and N. 35° W. fractures were actually formed, but since the schistosity trends N. 65° E., strong persistent fractures were developed in this direction, and short weak ones in the N. 35° W. direction. The strong northeast fractures were first filled with porphyry dikes, and later by successively younger ore deposits.

In the quartz monzonite stock the platy and linear structures indicate a somewhat funnel-shaped mass which pitches southwest at about 55°. Apparently, during emplacement, the magma moved upward at this angle in a northeast direction, and came up along the underside of the granodiorite mass. It seems probable that the northwest belt of breccia zones and fractures was formed as a result of combined upward force and drag in a northeast direction, developed during emplacement of the quartz monzonite stock.

Thus in the Jamestown district, and perhaps in other districts, the mapping of internal structures of intrusive masses related to ore deposits affords a valuable aid in attempting to solve the structural problems of ore distribution. (*Author's abstract.*) Discussed by Messrs. LOUGHLIN, FERGUSON, and LOVERING.

513TH MEETING

The 513th meeting of the Society was held in the Assembly Hall of the Cosmos Club, Feb. 28, 1934, President H. G. FERGUSON presiding.

Program: E. T. ALLEN: *Types of rock leaching by thermal waters in Yellowstone Park.* Discussed by Messrs. HESS, R. C. WELLS, GOLDMAN and TRASK.

A. I. JONAS: *Hypersthene granodiorite in Virginia; its change to unakite and its age.*—Hypersthene granodiorite occurs in three main belts in the western part of the Catoctin-Blue Ridge anticlinorium of Virginia. It is a grayish green rock made up of potash and plagioclase, feldspar, pyroxene, and quartz. Along the western side of the granodiorite areas it contains a varying

amount of pink feldspar, secondary epidote, and quartz. It has been called unakite where pink feldspar, epidote, and quartz are the chief constituents. Microscopic study shows the granodiorite has been subjected to a series of hydrothermal changes. It is thought that these hydrothermal changes were produced by action of residual magma extracts upon consolidated portions of the granodiorite. The changes include addition of silica to form quartz, of sodic solutions to form myrmekite and chessboard albite, and in part of the area, of the lime-iron silicate epidote and of ferric iron to form fine hematite flakes that color the feldspars pink. Unakite has been produced from the grayish green granodiorite by replacement of hypersthene and other constituents by epidote, change of gray-green feldspars to pink, and introduction of quartz filled with fine rutile needles, which impart blue color to the quartz.

In southwest Virginia the green schistose facies of the granodiorite with pink feldspars has been called the Grayson granite. It is bounded on the southeast by the Independence overthrust which has carried Lynchburg micagneiss northwestward over Grayson granite and infolded Unicoi quartzite. The Great Gossan lead occurs along this zone of thrust faulting.

The granodiorite is believed on stratigraphic grounds to be pre-Cambrian in age and older than the metabasalt flows which cap it in northern Virginia. In Nelson and Amherst counties the granodiorite contains allanite-bearing pegmatite. Analysis of allanite from the Friar, a granodiorite peak in northern Amherst County, gives a lead ratio that indicates an age of about 900 million years for the allanite, and it is probably middle pre-Cambrian in age. (*Author's abstract.*) Discussed by Miss BASCOM, and Messrs. FERGUSON, STOSE, and LOVERING.

J. S. WILLIAMS: *Correlation of the Louisiana limestone with beds at Kinderhook, Illinois, and Burlington, Iowa.*—The Louisiana limestone (lower Mississippian) is one of the formations of the Kinderhook group. Its type locality is in northeastern Missouri, and its outcrops are limited to this part of Missouri and to a small area in western Illinois. It occurs only in one of the four Kinderhookian provinces of Missouri, the northeastern province. The formations of this province, including two which may properly belong below the Kinderhook, are, in ascending order, the Grassy Creek shale, the Saverton shale, the Louisiana limestone, the Hannibal shale, and the Chouteau limestone. These formations are best exposed along the Mississippi River from central Lincoln County, Missouri, to central Marion County, Missouri. Most of them are, however, also recognizable in Illinois in counties east of and adjacent to the southern part of the Missouri outcrop area.

The type region for the Kinderhook group is in Illinois, near the town of Kinderhook, about 12 miles east of Hannibal, Missouri. Hannibal is in Marion County, Missouri, and is close to the northern edge of the northeastern Missouri Kinderhookian province. The best known and most fossiliferous Kinderhookian section in this region is, however, at Burlington, Iowa, about 80 miles north of Hannibal. It is not difficult to identify by lithology the beds at Kinderhook in the section at Burlington. It is, however, despite the proximity of these two sections to the northeastern Missouri province, impossible to correlate the Missouri beds with the beds at Kinderhook and Burlington by the ordinary physical means of correlation, a fact that has been stressed by nearly every investigator who has studied the sections. Direct tracing is impossible, well logs and other subsurface data are inadequate, and matching of lithologic units and successions, or of uncon-

formities does not give decisive results. Microscopic and chemical methods of physical correlation have not been attempted, but because of differences in the lithologies of the beds, they appear to promise little.

Faunal data are, when critically examined, of but little more correlative value than known physical data. This is especially true of correlations between the Missouri beds and beds at Burlington or Kinderhook. It is, however, less true in the correlation of the only really fossiliferous bed at Kinderhook with the Burlington section. Most faunal correlations that have been made appear not to have considered some of the unusual conditions that obtain in this area, or to have been actually based more on physical than on faunal data. Among the unusual conditions likely to affect the reliability of faunal correlations are the following: (1) common species are too few for definite conclusions (a change of an identification or two or of a stratigraphic range or two would very materially affect correlations); (2) work under way by Dr. G. H. GIRTY and the writer indicates that published ranges of several species are too narrow; (3) the total number of species (the fauna) varies greatly as between different beds in the sections; (4) the extent of a clearly demonstrated facies influence is not known; (5) the beds are thin and facies changes were rather frequent; (6) the lack of recent descriptive work and the composite origin of some of the fossil lists affects the reliability of the lists; and (7) differences in generic and specific concepts between various contributors to the available lists and changes in the application of these concepts by individuals from class to class and from time to time over a rather long period of years, render the use of lists on correlation uncertain.

The writer's study of the Louisiana fauna together with his observations on a considerable number of species from the Burlington section, and from nearly every one of the Kinderhookian beds of Missouri, influences him to agree with those parts of recent correlations that place beds 2 (of Weller) at Burlington and at Kinderhook stratigraphically above the Louisiana limestone. This conclusion is supported by the matching of species, the appearance of "new" genera and "new" species, and the relative percentages of species in the various beds. The writer cannot agree, however, that there are adequate faunal data for determining the age relation of the Louisiana limestone to beds 1 at either Kinderhook or Burlington or that there are adequate data for correlating strictly on a faunal basis, beds 2, 3, and 4 at Burlington or beds 2 or 3 at Kinderhook with any one bed in the Missouri section.

Most of the faunas appear to be local ones. The Louisiana fauna is certainly not represented as a fauna in either the Burlington or Kinderhook sections. The Louisiana limestone may have been eroded from the Burlington or Kinderhook regions or these areas may have been the sites of nondeposition or of deposition of different types of sediment during Louisiana time. A contemporaneous restudy of the faunas of all three sections is needed to make correlations more certain or to show definitely that under conditions such as obtain here, thin beds cannot be individually correlated. (*Author's abstract.*) Discussed by Messrs. BUTTS and STANTON.

514TH MEETING

The 514th meeting of the Society was held in the Assembly Hall of the Cosmos Club, Mar. 14, 1934, President H. G. FERGUSON presiding.

Informal communications: Mr. SPENCER exhibited and discussed a polished pebble from Gainesville, near Bull Run, Virginia.

Program: P. D. TRASK and H. F. HAMMAR: *Preliminary study of source*

beds in the Mesozoic rocks on the west side of the Sacramento Valley.—This paper presents results arising from an investigation of source beds of petroleum, sponsored both by the United States Geological Survey and the American Petroleum Institute. The paper is a preliminary report of a special investigation that has arisen in connection with the general study of source beds. An area on the west side of the Sacramento Valley in northern California underlain by a thick sequence of rocks of late Mesozoic age—that is, the Shasta series (Lower Cretaceous) and the Chico formation (Upper Cretaceous)—has recently been considered as prospective oil territory by several oil companies. Seeps of oil and gas are present and favorable structural features and reservoir rocks are known, but no oil in commercial quantity has yet been found. As the strata attain a thickness of 40,000 feet, the distribution of adequate source beds throughout this thick section is a very important question. The problem of the distribution of source beds was attacked by the writers by means of preliminary analyses of the organic content of 480 samples distributed fairly uniformly in the section, and by means of detailed analyses of the organic constituents of eight samples selected as being representative of these 480 samples. Definite conclusions about the possibilities of source beds in this area are difficult to reach because of the paucity of knowledge about the diagnostic characteristics of source beds. Nearly all the results that were obtained, however, lead to an unfavorable consideration of the sediments as source beds. The organic content is low and fairly uniform throughout the entire sequence of beds. The average organic content of the Shasta series is .87 percent and of the Chico formation .6 percent. The composition of the organic constituents of samples from the oil seeps is different from that of the sediments in the general section. This phenomenon suggests that sediments of the type that generate the oil at the seeps are not widely distributed through the general section.

The uniformity in quantity and character of the organic content of the Shasta and Chico sediments leads to the inference that almost any part of this sequence of strata is as likely to be favorable for source beds as any other part. Because of the failure to find oil in the wells that have already been drilled in this area, the uniformity of the organic content is not a favorable indication of the presence of adequate source beds of petroleum in the area. This inference about the uniformity of the organic content, however, is more encouraging with respect to source beds of gas, as significant quantities of gas have been reported from the Buttes well of the Buttes Oilfields Inc., and also from the Guinda well of the Nigger Heaven Dome Oil and Gas Co. However, despite the discouraging aspect indicated by the results of this investigation, the evidence is not very positive in character, and in no way condemns the area. It is entirely possible that adequate source beds may be present. (*Authors' abstract.*) Discussed by Miss STADNICHENKO, and Messrs. HESS, WHITE, and ROBINSON.

T. S. LOVERING: *Physiography of the Colorado Front Range.* Discussed by Messrs. MATTHES, WHITE, TRASK, KOSCHMANN, and BUTTS.

515TH MEETING

The 515th meeting of the Society was held in the Assembly Hall of the Cosmos Club, Mar. 28, 1934, President H. G. FERGUSON presiding.

Informal communications: H. D. MISER announced and discussed an angular unconformity on the northeast side of the Arbuckle Mountains. Discussed by Messrs. HENBEST and GOLDMAN.

H. G. FERGUSON on behalf of Mr. SHENON described fissures developed in the recent earthquake in Utah.

Program: J. C. MILLER: *The relation of geology to unit operation of oil and gas fields.* Discussed by Messrs. LOVERING and GAZIN.

R. W. BROWN: *The pronunciation of geologic terms.*—Above all other influences operating in the English language, the tendency to shift accent in a polysyllabic word from a root element to a new syllable that is meaningless, is the chief cause for diversity in the pronunciation of geologic and other scientific terms. Thus we hear ki-lom-eter for kilo-meter; ba-rom-eter for baro-meter; psi-lom-elane for psilo-melane; am-phib-olite for amphi-bolite; Dry-op-teris for Dryo-pteris; Quer-cox-ylon for Querco-xylon; Gas-trop-oda for Gastro-poda; tril-oba for tri-loba. The remedy for this situation is held to be a general agreement among scientists to disregard classical rules, for the most part, and to pronounce scientific terms so that the root elements can be heard as distinct units. (*Author's abstract.*) Discussed by Messrs. MATTHES, TRASK, SPENCER, LOVERING, MISER, and BOWMAN.

R. M. LEGGETTE: *Varved clay in Ogden Valley, Utah.*—Ogden Valley lies in the Wasatch Mountains about 10 miles east of the city of Ogden, Utah. It is a graben valley formed in early Tertiary time and is filled with more than 600 feet of unconsolidated gravel, sand, and clay. During the Bonneville stage of Lake Bonneville (5,200 feet) an arm of the lake extended eastward through a narrow canyon in the Wasatch Mountains and flooded Ogden Valley. Sediments were deposited during this high water stage that completely filled the valley up to an altitude of about 4,900 feet. With the overflow of Lake Bonneville and the cutting down of its outlet about 400 feet to the Provo stage, the Ogden Valley was drained and the streams began entrenching the 4,900-foot bench.

A deposit of varved clay, about 70 feet thick, underlies a considerable portion of the valley. A count of the varves on a number of specimens shows about 370 years per foot of varved clay. The more silty portions show about 160 years per foot. When these figures are applied to the clayey and silty portions of the total thickness of varved material it is found that about 23,000 years is represented by the 70 feet of varved clay. This does not represent an accurate figure, but should be considered only as indicating the general order of magnitude, perhaps 25,000 years.

The upper part of the varved clay lies above the level of the Provo stage of Lake Bonneville, and the clay, therefore, could not have been deposited during the Provo stage. The clay could not have been deposited in a small lake occupying Ogden Valley that was not connected to the main Lake Bonneville, because the varved clay lies higher than the overflow point of the valley through Ogden Canyon. The early Pleistocene stage of Lake Bonneville was high enough to allow the formation of the varved clay. However, there is no major break represented in the sediments above or below the varved clay and it is, therefore, believed that the varved clay and the overlying and underlying sand and gravel were deposited during the Bonneville stage of Lake Bonneville. The Bonneville stage presumably represents only a part of Wisconsin time and the varved clay which was deposited in about 25,000 years therefore represents only a part of Wisconsin time. (*Author's abstract.*) Discussed by Messrs. ALDEN, BRADLEY, FERGUSON, and THOMPSON.

516TH MEETING

The 516th meeting of the Society was held in the Assembly Hall of the Cosmos Club, Apr. 11, 1934, President H. G. FERGUSON presiding.

Informal communications: R. M. LEGGETTE discussed the recent earthquake in Ogden Valley, Utah, with epicenter at northeast corner of Great Salt Lake. The quake was recorded at well stations by water stage recorders and pressure recorders. Graphs were exhibited showing effects of earthquake registered by both types of recorders. The data suggest that the pressure recorders offer a new line of attack in earthquake study.

Program: H. D. MISER: *The Carboniferous rocks of the Ouachita Mountains.*—The Carboniferous rocks of the Ouachita Mountains are a great succession of sedimentary strata, chiefly shale and sandstone, measuring 18,000 to 20,000 feet in thickness in most parts of the region. The great quantity of sediments for these rocks was derived from the Paleozoic land Llanoria of Louisiana and eastern Texas and accumulated in the adjoining geosynclinal belt, which is concealed by Cretaceous and Tertiary deposits, except for the exposure in the Ouachita Mountains of Arkansas and Oklahoma, and other exposures in the Marathon and Solitario regions of Texas. All of the above thickness of Carboniferous rocks is of Pennsylvanian age, except for a few hundred feet of Mississippian shale (Caney shale) that is exposed in Ti Valley and at Wesley, Okla. If to this thickness of Pennsylvanian strata there be added the thickness of the younger Pennsylvanian rocks of the Arkansas Valley, the grand total reaches about 25,000 feet. The Ouachita Mountains and the adjoining Arkansas Valley, therefore, reveal the thickest known section of Pennsylvanian rocks in the United States.

In the past there has been much discussion about the age assignment of a large portion of the Carboniferous sequence. There has seemed to some geologists, including myself, to be some evidence for a Mississippian age assignment for the Hot Springs sandstone, Stanley shale, and Jackfork sandstone, and for a portion of a boulder-bearing shale on top of the Jackfork sandstone. On the other hand, there has seemed to other geologists, including Ulrich, to be much evidence for a Pennsylvanian age assignment for these formations whose combined thickness is about 12,000 feet.

The age significance of the plant evidence, which has been critically reviewed and studied by David White, is discussed by him in a manuscript paper given before the Dallas meeting of the American Association of Petroleum Geologists. An invertebrate fauna obtained by me recently from the Jackfork sandstone seems to be the first one to contain identifiable fossils of value. A statement concerning the age indications of the fauna has been given me by G. H. Girty. The evidence of the invertebrate and plant fossils is in agreement for indicating a Pennsylvanian age for the Hot Springs sandstone, Stanley shale, and Jackfork sandstone. A Pennsylvanian age assignment for the boulder-bearing shale has already been demonstrated by Bruce Harlton on the basis of microfossils.

With a Pennsylvanian age assignment for these formations it now becomes possible for me to reach a more satisfactory conclusion than I have been able to reach hitherto, concerning the nature and origin of the boulder-bearing shale which rests upon the Jackfork sandstone. This shale is here designated Johns Valley shale, in accordance with E. O. Ulrich's usage proposed in 1927. The deposits of erratic boulders are found along and near the northern margin of the Ouachita Mountains and lie within the Oklahoma structural salient, whose northern frontal margin marked by the Ti Valley fault has been thrust toward the northwest, a distance of 20 miles or more over rocks of the Arbuckle Mountain facies. The boulders have, I believe, been derived from an early Pennsylvanian uplift which has been largely, if not entirely, concealed by the northwestward overthrust of the Oklahoma

structural salient in late Pennsylvanian time. My ideas of the location of the uplift thus accord with those as expressed by Sidney Powers.

I question the ice-rafting hypothesis for the transportation of most of the erratic boulders because of the great size of the erratic masses of Caney shale (Mississippian) measuring as much as 600 feet across, that are embedded in the Johns Valley shale (Pennsylvanian), because of the great size of many limestone blocks measuring as much as 370 feet long that are found in the Johns Valley shale, and because of the apparent local source of the exotic material. E. E. L. Dixon's hypothesis that the boulders represent submarine land slips from high scarps on the uplift that has been postulated by Powers, seems to accord with most of the available evidence. The hypothesis for the origin of the boulders by thrust faulting seems to have fatal objections. There are no repetitions in the sequence, as would be expected from overthrust faulting. Nor are any of the boulders found along the faults that bound the northwestwardly overthrust sheets of the Oklahoma structural salient. Instead, the boulders are confined to a single formation, the Johns Valley shale.

The orogeny forming the hypothetical uplift from which the erratic boulders may have been derived in early Pennsylvanian time appears to have taken place coincident, or nearly coincident, with a widespread early Pennsylvanian orogeny that, according to C. W. Tomlinson, Sidney Powers, and Robert H. Dott, affected a large region in southern Oklahoma, including the Criner Hills and Arbuckle Mountains. (*Author's abstract.*) Discussed by Messrs. ULRICH, FOERSTE, STOSE, and FERGUSON.

DAVID WHITE: *The age of the Stanley and Jackfork formations.* Discussed by Messrs. MISER and ULRICH.

517TH MEETING

The 517th meeting of the Society was held in the Assembly Hall of the Cosmos Club, April 25, 1934, President H. G. FERGUSON presiding.

Program: A. H. KOSCHMANN: *The geology of the new deep tunnel of the Cripple Creek District.* Discussed by Mr. MANSFIELD.

G. F. LOUGHLIN: *Groundwater and deep ore reserves of the Cripple Creek District.* Discussed by Messrs. GILLULY, LINDGREN, FERGUSON, and GOLDMAN.

W. H. BUCHER: *Limestone blocks in volcanic breccia on Shoshone River, Wyoming.* Discussed by Messrs. LOUGHLIN, KOSCHMANN, FERGUSON, WOODRING, LARSEN, GILLULY, BRIDGE, HESS, TRASK, ALDEN, and MISER.

SCIENTIFIC NOTES AND NEWS

Prepared by Science Service

Biological Survey, U. S. Department of Agriculture.—JAY N. DARLING and W. C. HENDERSON, chief and associate chief, respectively, of the Bureau of Biological Survey, on September 11 addressed the International Association of Game, Fish and Conservation Commissioners at their annual meeting in Montreal. Outlining the Bureau's program for national wildlife restoration, Mr. DARLING spoke on *Conserving and restoring waterfowl.* Mr. HENDERSON in a paper entitled *The waterfowl crisis* summarized the results of the extensive studies recently made by the Biological Survey.

On September 6, Mr. HENDERSON discussed wildlife and forestry at a forestry-and-land-use session of the annual forestry conference held in Plymouth, N. H., by the Society for the Protection of New Hampshire Forests in

cooperation with the New Hampshire Forestry Commission. W. L. McATEE and J. PAUL MILLER also represented the Biological Survey at the conference.

National Bureau of Standards.—On recommendation of the Department of State, Dr. J. H. DELLINGER, chief of the radio section, was appointed chairman of the American delegation to the International Radio Consulting Committee which met in Lisbon, Portugal, from September 22 to October 10. The other official delegates were Major ROGER B. COLTON, Signal Corps, United States Army; G. C. GROSS, Federal Communications Commission; Captain STANFORD C. HOOPER, United States Navy; and W. VALLIE WHITINGTON, Treaty Division, Department of State.

The International Radio Consulting Committee was established in 1927 to advise the radio administrations of the world on technical questions, the principal objective being the reduction of radio interference. Shortly after the committee convened in Lisbon, Dr. DELLINGER was elected one of the vice presidents.

Dr. DELLINGER also attended a session of the International Scientific Radio Union in London, September 11 to 19. This is one of the organizations in the International Council of Scientific Unions in which the United States is represented through the National Research Council. The London meeting dealt with radio measurements and standards, propagation of waves, atmospherics, and radio physics. Four reports were presented by Dr. DELLINGER on radio frequency standards, analysis of continuous records of field intensity at broadcast frequencies; frequency distribution of the intensities of radio atmospherics, and report on Polar Year observations.

The American Congress of Physical Therapy has announced the award of its gold key, "the highest honor within the power of the Congress to bestow," to Dr. W. W. COBLENTZ, chief of the radiometry section of the National Bureau of Standards, and member of the Council on Physical Therapy of the American Medical Association, "for meritorious service to medical science in the field of ultra-violet radiation."

National Park Service, U. S. Department of the Interior.—Director ARNO B. CAMMERER, Assistant Director HAROLD C. BRYANT, and Chief Naturalist EARL A. TRAGER have returned to Washington from extensive western park trips.

Former Director HORACE M. ALBRIGHT of the Service has been honored in the naming, as *Albrightia*, of one of our genera of algae segregated and identified by Dr. JOSEPH J. COPELAND, New York scientist, while in Yellowstone National Park during the past summer. Another newly indentified genus has been given the name *Coulteria*, for the late Prof. JOHN COULTER of the University of Chicago, who began his botanical career as a member of the Hayden Expedition of 1872.

Children's Bureau, U. S. Department of Labor.—Cooperating with the Institute of Human Relations and the Pediatric Department of Yale University School of Medicine, the Children's Bureau is undertaking this autumn a three-year study of the physical fitness and growth of a group of school children in the public schools of New Haven. The purpose of this study is to evaluate certain indices of nutrition and development of children. It is proposed to examine approximately 1,200 six-year-old children entering the schools in September. A series of physical measurements will be made. At

the end of three months the children will be reweighed, and thereafter every three months during the year. The same group of children will be re-examined in the fall of 1935, and again in the fall of 1936 by the same physician.

At the request of the National Industrial Recovery Administration, the Children's Bureau, together with the Women's Bureau of the U. S. Department of Labor, is making a study of industrial home work in different localities. Field work has been carried on in Maine, New York, New Jersey, and Philadelphia and will be continued in Connecticut, Iowa, Illinois, and Texas. Tabulation of findings has already begun. Home work industries studied include those in which home work is still permitted without regulation, those in which it is regulated, and those in which it is now prohibited, information from the last being obtained in order to show how the manufacturers and employers have adjusted their industries to the prohibition of home work. The information obtained in this study will cover hours worked and rates paid for home work, the number of children engaged in these occupations, and other data which will provide a basis for dealing with this problem by the NRA.

Bureau of Fisheries, U. S. Department of Commerce.—At the twenty-first meeting of the North American Council on Fishery Investigations, held at Halifax, N. S., on September 19, the United States delegation consisted of Dr. H. B. BIGELOW, chairman of the Council, CHARLES E. JACKSON, deputy commissioner of fisheries, and ELMER HIGGINS. Also in attendance from the Bureau of Fisheries were O. E. SETTE and W. C. HERRINGTON. The meeting was uniquely notable, in that it was the first one of the Council in its fourteen years of activity to be held on what is technically French soil. The sessions were held on board the new French fisheries research vessel *President Theodore Tissier*. The next meeting of the Council will be held in Washington, D. C., in September, 1935.

Recent researches by Dr. P. S. GALTSOFF, chief oyster investigator, assisted by J. F. REPPUN, indicate that while spawning of the females of the native North Atlantic oyster species can be stimulated by the presence of sperm from Japanese oysters, such spawning will not occur in response to sperm from a number of other mollusks or from echinoderms. Dr. GALTSOFF has also shown that the oyster sperm contains an active principle or hormone-like compound which can be isolated. A quantity of this compound has been prepared and is being used in biological studies.

The Venezuelan Legation has arranged with the Bureau of Fisheries for a consignment of miscellaneous river fishes to be shipped to Venezuela, where an effort will be made to propagate them for introduction in the freshwater bodies of that country.

American Chemical Society.—Five Washington men have been elected to fill posts in the American Chemical Society. They are: Dr. WILLIAM D. APPEL of the Bureau of Standards, who will head the Division of Dye Chemistry; Dr. HORACE T. HERRICK of the Color and Farm Waste Division, Bureau of Chemistry and Soils of the U. S. Department of Agriculture, secretary of the Dye Division; Dr. CHARLES A. BROWNE, also of the Bureau of Chemistry and Soils, member of the Executive Committee of the Division of History and Chemistry; Dr. ALDEN H. EMERY of the U. S. Bureau of Mines, re-elected secretary-treasurer of the Division of Gas and Fuel Chemistry, and Dr. CLAUDE S. HUDSON of the Hygienic Laboratory will serve on the Executive Committee of the Division of Organic Chemistry.

Georgetown University School of Medicine.—The Rev. DAVID A. MCCAULEY, S.J., chairman of the department of biology was appointed to succeed Rev. JOHN L. GIPPRICH, S.J., as regent of the Schools of Medicine and Dentistry. Father MCCAULEY is a native of New York City and entered the Society of Jesus in 1913. He was successively assistant professor of biology at Fordham University, professor of biology at Holy Cross, and later at Canisius College, and finally he was for the past three years professor of empirical psychology and biology at the Jesuit Seminary at Woodstock, Maryland. Father MCCAULEY is a morphologist by training, and his special field of interest in the field of exact sciences is neuro-anatomy.

Mr. GEORGE A. BENNETT resigned as professor of anatomy. Dr. JOSEPH L. SCHWIND formerly of Cornell University College of Medicine was appointed professor of anatomy and acting chairman of the department. The following appointments have also been made in the department of anatomy: Dr. JOHN J. LAWLESS, and Dr. RUSSELL L. JONES, both formerly of the University of Minnesota, as instructors in anatomy.

The following special lecturers have been appointed in the department of bacteriology: Dr. R. E. DYER, assistant director, Dr. CHARLES ARMSTRONG, surgeon, Dr. EDWARD FRANCIS, medical director, and Dr. R. R. SPENCER, surgeon, all of the National Institute of Health. They will give lectures on rickettsia, smallpox vaccination, tularemia, and dysentery respectively.

The department of pathology purchased a new sledge microtome for cutting sections of whole organs. Prof. WHITMORE is continuing his work on the biologic action of radiant energy and the endocrine origin of lesions in bones and in the breast. Associate Professor DARDINSKI has just completed the anatomical study of the ampulla Vater in different morbid conditions.

The department of pharmacology purchased apparatus for extensive toxicological research and for the study of placental permeability of drugs. Prof. T. A. KOPPANYI and his associates published numerous papers on the colorimetric estimation of veronal derivatives and on the action of barbiturates in the living tissue. As a result of these researches a new conception of anesthesia was developed. Dr. KOPPANYI and his associates also succeeded in the experimental production of lasting intracranial hypertension.

George Washington University School of Medicine.—The School celebrated the opening of the one hundred tenth academic year on September 19. Addresses were delivered by President CLOYD HECK MARVIN president of the University and Dr. WILLIAM J. MALLORY, professor of medicine. Among the distinguished visitors and guests present were Prof. JOHN REENSTIERNA, department of bacteriology, University of Upsala, Sweden; Capt. HAROLD SMITH, Commandant, United States Navy Medical School, and Col. P. W. HUNTINGTON, Commandant, United States Army Medical School. Dr. E. B. MCKINLEY, dean of the School of Medicine, announced the following new appointments to the teaching staff: Dr. HERBERT P. RAMSEY, assistant professor of obstetrics and gynecology; Dr. WADE H. MARSHALL, instructor, department of physiology; ALMA FOGELBERG, instructor, department of physiology; Dr. RANDALL L. THOMPSON, research associate in bacteriology; Dr. IRMGARD DRESEL, instructor, department of pathology; Dr. ELIZABETH RAMSEY, instructor, department of pathology; Dr. DUANE CASE RICHTMEYER, research assistant in experimental medicine; Dr. G. LOUIS WELLER, Jr., clinical instructor in medicine; Dr. HARRY F. DOWLING, clinical instructor in medicine; Dr. RUSSELL F. FIELDS, clinical instructor in dermatology and syphilology; Dr. BYRON RIEGAL, research assistant in

biochemistry; Dr. ALEXANDER SIMON, clinical instructor in neurology; Dr. KATHERINE E. PARKER, instructor in obstetrics and gynecology.

NEWS BRIEFS

The thirty-fourth annual conference of the Federation Aeronautique Internationale was held in Washington, October 6 to 11. The program included a visit, on October 7, to the laboratories of the aeronautic instruments section of the National Bureau of Standards. Dr. W. G. BROMBACHER, chief of the section, had some interesting instruments and testing equipment to show the visitors. The Federation is the aviation sport governing body of the world, the United States being represented through the National Aeronautic Association. In all, twenty-one nations were represented at the conference.

Because of the adverse ruling of Comptroller McCarl, the Forest Service will be unable to begin the immediate development of the great shelter-belt project in the West. Approximately one million dollars at present available will be expended in research, exploratory work, and the expansion of nursery stocks, to be used in the event that the next Congress makes an appropriation for this purpose.

A strong appeal for the rescue of the almost extinct trumpeter swan has been issued by Secretary of the Interior HAROLD F. ICKES. At present, the remnant of the species is confined almost entirely to the waters of Yellowstone National Park and the immediate vicinity.

Preliminary studies are under way at the Catholic University of America looking to the possible establishment of an "alphabet grove," a famous institution in ancient Ireland, in which each of the eighteen letters of the Irish alphabet was represented by its "name tree."

PERSONAL ITEMS

Under Secretary of Agriculture REXFORD G. TUGWELL was official representative of the U. S. Department of Agriculture at the autumn meeting of the International Institute of Agriculture, at Rome.

Dr. AGESILAU BITANCOURT, associate director of the plant division of the Biological Institute of the Department of Agriculture of the State of Sao Paulo, Brazil, was the guest of the U. S. Department of Agriculture during the latter part of September.

Dr. HANS LAUER, professor of ophthalmology, the University of Warsaw, Poland, addressed the faculty and students at the school of medicine, George Washington University, on Tuesday, October 2. Dr. Lauer's subject was, *Heredity, particularly in relation to the eye.*

Dr. J. E. I. CAIRNS, of the Department of Terrestrial Magnetism, Carnegie Institution of Washington, who has been stationed at the Huancayo Magnetic Observatory, in Peru, since August 1931 and in charge of the Observatory since December 1, 1932, returned to Washington, D. C., on September 27.

F. T. DAVIES, of the Department of Terrestrial Magnetism, Carnegie Institution of Washington, who has been on furlough since February 16, 1932,

in order that he might take part in the Polar Year work at the Canadian station at Chesterfield Inlet, and afterwards participate in the reduction of the observations at the Meteorological Service, Toronto, returned to take up his duties at the Department of Terrestrial Magnetism in October.

Miss RUTH O'BRIEN, chief of the division of textiles and clothing, bureau of home economics, U. S. Department of Agriculture, spoke on *Standards for consumers' goods* before the meeting of the Conference on Distribution, Boston, on September 25.

Dr. CHARLES F. ROOS, chief of the research and planning division of the NRA, and from 1930 to 1932 permanent secretary of the American Association for the Advancement of Science, has been appointed professor of economics at Colorado College.

Correction.—With reference to the paper *Pleistocene remains found near Lake Tacarigua, Venezuela* by Charles Berry, published in this JOURNAL **24**: 387–395, October 1934, the author wishes to add a statement to the effect that the term *Pleistocene* was used in a loose sense for everything from Pleistocene to Recent, since there was no means of making a distinction at that locality.